

—A—

LABORATORY MANUAL

—OF—

PATHOLOGICAL ANATOMY,

—BY—

DELANO AMES, A. B., M. D.

BALTIMORE, MD.

1896.

LIBRARY
SURGEON GENERAL'S OFFICE

NOV-6-1897

160024

PRINTED BY
C. A. HASKELL,
1 South Calvert Street,
BALTIMORE, MD.

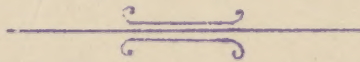


LABORATORY MANUAL

— of —

Pathological Anatomy

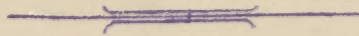
SECOND EDITION



FIRST PART:

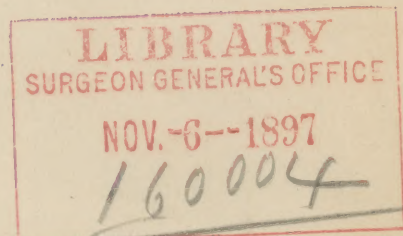
DISEASES OF

The LIVER SPLEEN & PANCREAS.



1896.

COPYRIGHTED BY
DELAND AMES, M. D.
1896.



Annex

QZ

q A513L

1896

Film not 1033b, 4cm b

**COPYRIGHTED BY
DELANO AMES, M. D.
1895.**

CONTENTS:

<u>Normal Structure in Brief.</u>	Page	3
<u>Cloudy Swelling</u>	"	7
<u>Chronic Passive Congestion</u>	"	8
<u>Fatty Infiltration</u>	"	11
<u>" Degeneration.</u>	"	14
<u>Amyloid Disease</u>	"	17
<u>Cirrhosis</u>	"	19
<u>Hypertrophic Cirrhosis</u>	"	23
<u>Fatty</u> "	"	25
<u>Perihepatitis</u>	"	26
<u>Acute Interstitial Hepatitis</u>	"	27
<u>Congenital Syphilitic Cirrhosis</u>	"	29
<u>Syphalitic Gummata</u>	"	30
<u>Typhoid Lesion</u>	"	33
<u>Leucocythaemia</u>	"	34
<u>Tuberculosis</u>	"	35
<u>Abscess of the Liver</u>	"	39
<u>Pigmentary Infiltration of the Liver</u>	"	41
<u>The Spleen</u>	"	42
<u>The Pancreas</u>	"	48

DISEASES OF THE LIVER.

Normal Structure In Brief.

For a full account of the anatomy and histology of the liver read either Quain's or Gray's Anatomy.

The liver is the largest organ in the body. Its average weight in the adult is about 3 pounds (1,488 grams). It lies chiefly on the right side of the abdomen, though a portion of the lesser, or left lobe passes the median line and lies upon the left side.

The organ is covered by a thin glistening fibrous tissue capsule composed of a superficial and of a deep layer. The superficial layer is continuous with the peritoneum, while the deep layer dips into the organ in innumerable places and forms its supporting structure. Where ever these small bands

of fibrous tissue from the deep layer of the capsule enter the liver they are accompanied by branches of the portal vein, the hepatic artery, and the bile ducts, the whole group being known as a portal system or a portal canal.

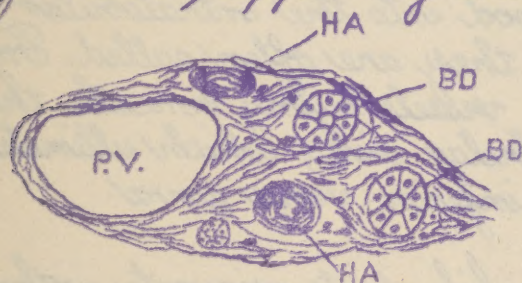


FIGURE I.

A portal Canal = P.V. Portal Vein.
HA. = Hepatic Artery. BD. = Bile Ducts

The great mass of the liver is made up of liver cells. These are finely granular, polygonal, nucleated bodies, arranged in a lobular manner with reference to the terminal branches of the hepatic vein. In many animals this lobular arrangement is very distinct, small bands of connective tissue separating one from another, but in man no such definite demarcation can be seen. Each lobule consists of a mass of liver cells, arranged roughly in columns about a central vessel, the intralobular hepatic vein, into which open many minute capillaries bringing the blood

from the portal vein and the hepatic artery. While the terminal branches of the hepatic vein are found in the centre of the lobules, about their periphery, at the points of contact of several lobules will be found the portal systems.

Circulation:—The circulation within the liver is of importance, the organ having two distinct blood supplies, one arterial and the other venous.

Arterial blood is supplied by means of the hepatic artery, the small branches of which follow, as already stated, the ramifications of Glisson's capsule.

Venous blood is supplied by means of the portal veins which also ramify with the hepatic artery, and bile ducts in the portal systems. Blood from these two sets of vessels finds its way by a series of intralobular capillaries, which lie between the cells of the outer portions of the lobule, into the capillaries already mentioned as lying between the cells of the inner portions, and which empty their blood into the intralobular hepatic veins, or the central veins as they are often called. From these veins it is taken up by larger vessels lying beneath the lobules and hence called the sublobular veins, which ultimately empty as the hepatic veins into the inferior vena cava.

Origin of the Bile Ducts:—The bile ducts originate within the liver lobules. Where two or more liver cells are grouped together the minute radicles of these ducts begin. At first these small channels are strictly intercellular, each liver cell being

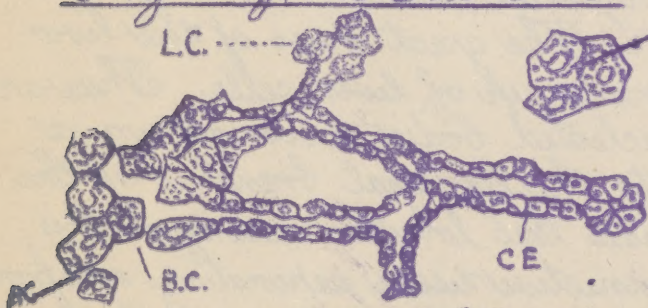


FIGURE 2. (after Klein & Smith)

Commencement of bile-ducts.

B.C.—Bile Canaliculi between liver cells.

L.C.—Liver Cells slightly modified just before beginning of bile duct.

C.E.—Cuboidal Epithelium of a large duct.

grouched along its sides, and where two cells come into apposition a channel is thus formed. Innumerable channels

so formed communicate in all directions forming a most extensive net-work of capillary vessels. As these channels increase in size they cease to be intercellular as at first and become lined by a layer of small flat cells which as the duct increases in size increase also, until ultimately the bile ducts are well defined tubes lined by a cuboidal epithelium seated upon a basement membrane about which there is developed a slight muscular coat. According to some observers the bile capillaries begin as minute channels within the protoplasm of the cells and then come to lie as just mentioned in grooves between several cells.

Until recently the portal canals were looked upon as marking the periphery of lobules, while the hepatic veins indicated their ^{ing} centre. According to some observers however this is considered incorrect. These authors look upon the hepatic veins as marking the periphery, while the portal canals indicate the centre of the true hepatic lobules. About the hepatic veins they claim a series of glandular acini are arranged which converge with those from other hepatic veins, to a portal canal as a centre. Each acinus is conceived as composed of a mass of liver cells grouped about a bile duct into which empties an extensive capillary system. The liver cells secrete the bile which is taken up by the minute capillaries and conducted to the main bile duct, the duct for the gland and which lies in a portal system with its portal vein and hepatic artery.



FIGURE 3.

Sabourin's Scheme of a Hepatic Acinus.

A. Hepatic artery. B. Bile duct.
P. Portal vein. H. Hepatic vein.

Pathological Zones:—Returning however to the older conception of the liver lobule, we may for convenience sake divide it into three zones, each occupying about one-third of its area. Of these the outer is spoken of as the peripheral, or portal vein zone, and in it we first find the fatty changes to which the liver is subject.

The middle third of the lobule⁶ is spoken of as the intermediate zone, or the zone of the hepatic artery, because here the portal vein capillaries and those from the hepatic are supposed to anastomose. In this area we first find waxy changes. The inner third is spoken of as the zone of the hepatic vein, or central zone. In it are found the capillaries which empty into the central vein and here we meet the first evidences of passive congestion of the liver.

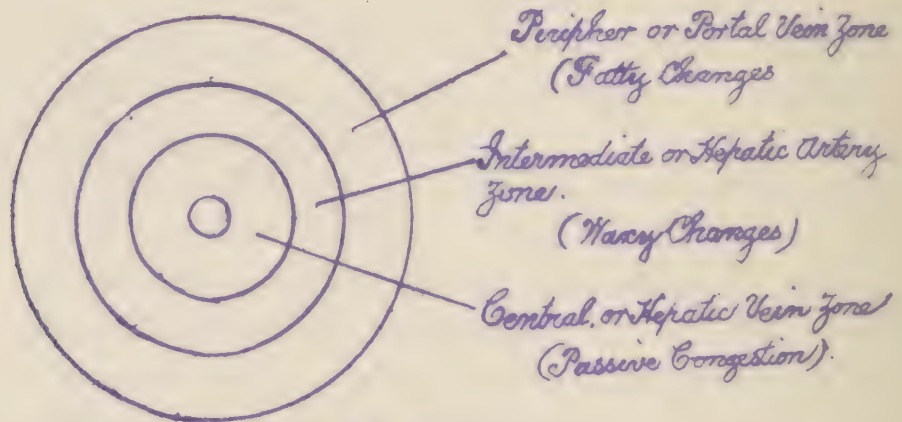


FIG. 4. Diagram of Lobular Zones.

CLOUDY SWELLING.

Synonyms:- Parenchymatous inflammation. Parenchymatous Degeneration.

Definition:- A change in the liver characterized by a swollen granular condition of the liver cells.

Etiology:- Cloudy swelling has been described by Virchow as a parenchymatous inflammation of the cells of the part, an early expression on their part of an inflammatory process. (See Lecture notes on Cloudy Swelling). The condition is found accompanying septic fevers and all acute febrile affections.

Pathological Anatomy:- Very little can be said of the gross appearances of a liver which is in a state of cloudy swelling. In consistency the organ is rather flabby and the color is somewhat lighter than normal. The capsule is usually rather tense, indicating that the liver is somewhat enlarged.

Pathological Histology:- Under the low power of the microscope it can be seen that the liver cells apparently take up more space than usual and that in consequence the capillaries are compressed and contain but little blood. This fact probably accounts for the somewhat lighter color of the organ. Some proliferation of the connective tissue may be seen but it is not marked.

Under a higher magnification the cells, especially those of the portal zone (the outer zone) appear somewhat enlarged; they are more rounded than normal and within each can be seen numerous small granules which give to the protoplasm a cloudy look. The nucleus too is somewhat indistinct. If the condition be advanced, many of the cells will be found broken up into a fatty granular detritus. Fatty degeneration is one of the terminations of cloudy swelling though if the cause be removed before the process is too far advanced the cells will return to their normal condition.

CHRONIC PASSIVE CONGESTION

Synonyms - Venous Congestion. Nutmeg Liver. Central Red Atrophy (Virchow) Cyanotic Atrophy.

Definition - A condition of the liver characterised by an over-fullness of the hepatic venous system with blood, and in advanced cases by atrophy of the liver cells from pressure.

Etiology - Chronic passive congestion is a condition brought about purely by mechanical means. Anything which will hinder the efflux of blood from the hepatic veins will produce it. Thus for example the most frequent cause is disease of the mitral, or of the tricuspid valve allowing at each systole the back flow of a certain amount of blood. If the lesion be tricuspid regurgitation the liver soon becomes affected, for at each cardiac contraction a portion of the blood which should have gone on to the lungs is forced backward into the right auricle thereby preventing the entrance of a certain amount of venous blood from the venae cavae. This produces a condition of over-fullness of the inferior vena cava, which in turn reflects upon the hepatic veins which open into it. (Explain the way in which mitral regurgitation produces chronic passive congestion of the liver.)

Of other conditions which can cause venous congestion of the liver, lung changes which interfere with the pulmonary circulation, are the most common. Thus chronic interstitial changes and emphysema by causing a hindrance to the passage of blood through the lungs force a certain amount back upon the right heart and upon the venae cavae. Tumors pressing upon the inferior vena cava will also produce congestion of the liver.

Pathological Anatomy - We may recognise at least two

stages in this condition, an early stage and an advanced. In the early stage we find the liver somewhat enlarged, its capsule tense and glistening and of a purplish red color. Its consistency is now not much altered. In the advanced stage, we find that the organ has shrunken to something less than its normal size, its capsule is no longer glistening, but is wrinkled and dull. Its consistency it is considerably firmer than normal.

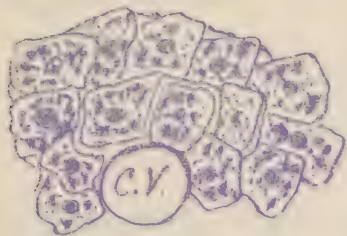


FIGURE 5.

Early "Nutmeg" liver, unstained.

Portion of lobule showing pigment in the cells around the central vein.

Upon section, in both stages, there is a plentiful escape of blood and upon closely examining the cut surface a distinct mottled appearance is made out. The centre of each individual lobule is seen to be of a deep red color while surrounding this can be seen a band of lighter tissue. If in the early stage, the central red portion will be small and the surrounding band of lighter tissue broad; while in the advanced stage the central portion will be large and the band of light tissue narrow. This mottled appearance has lead to the name "Nutmeg Liver" for this condition.

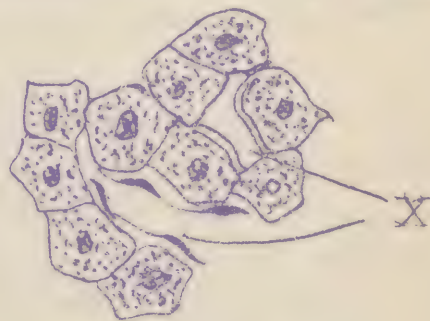


FIGURE 6

Chronic Passive Congestion.

Pathological Histology: In very mild grades of this disease, to here there may be very few gross appearances, or even none at all to call attention to it, we find upon microscopic examination a slight dilatation and engorgement of the capillaries in the zone of the hepatic vein, the centre of the lobule with a deposit of golden-brown pigment in the liver cells about them.

X - Dilated Capillaries showing the cells of their walls at some distance from the liver cells (x600)

As the disease advances the capillaries become more and more engorged and distended, and the columns of liver cells narrower. Closely examining the capillaries one can make out their walls with much greater ease than in the normal organ, and in many places a distinct space between them and the columns of liver cells can be demonstrated.

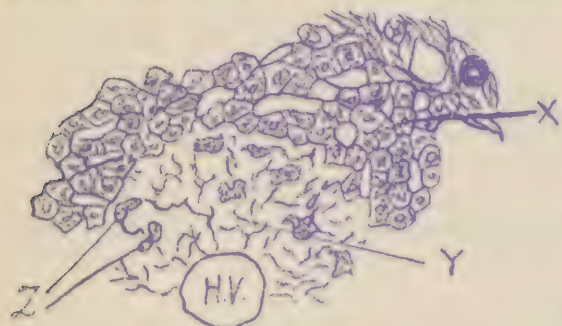


FIGURE 7.

Portion of a lobule in Advanced Central
Red Atrophy.

H.V. - Dilated Central vein. X - Zone of comparatively normal liver cells at periphery of lobule. Z - Atrophic granular liver cells. Y - Central portion of the lobule in which all liver cells have been destroyed showing a reticulum of capillary walls. The blood has been washed out in preparation.

In the most advanced stages we find in the zone of the hepatic vein, a tremendous dilatation and engorgement of all the capillaries, and either an entire absence of liver cells, or the shrunken pigmented remains of a very few. The centre of each lobule seems to be converted into a mesh-work of blood containing tissue. Here and there where the blood has escaped from the capillaries and their walls have collapsed, an appearance very much resembling connective tissue is produced. In some instances where we would expect to find

only a mass of blood, we find that, due probably to some post mortem change, or to the process of hardening and embedding, all the blood has escaped, and we only see a central reticular mesh-work of empty capillaries. As we proceed outward from the central area we come upon liver cells in all stages of degeneration and atrophy from the pressure exerted upon them by the distended capillary vessels, until finally at the extreme periphery, there is a narrow band of fairly normal cells.

FATTY INFILTRATION OF THE LIVER

Synonyms. - Fatty Liver. Steatosis of the Liver.

Definition. - A condition of the liver characterized by a deposit of fat within the liver cells.

Etiology. - Accumulation of fat within the cells of the liver is in part a physiological process. Normally after a hearty meal there is an increase of fat within the liver which disappears within a short time. When however the amount of such fat increases beyond a certain point, or remains unconsumed beyond a certain length of time the process passes beyond the physiological limit and becomes pathological.

Fatty infiltration is met with under a variety of conditions. It is very frequently found in corpulent persons. All conditions which diminish oxidation tend to increase the deposit of fat in the liver as elsewhere, and rich food with lack of exercise combined therefore favor its formation. In these cases it indicates a condition of the body in which there is a surplus of carbonaceous nourishment over what is required by the system.

Alcohol, also when used to excess leads to fatty infiltration of the liver. This is probably to be explained by the fact that alcohol is more easily oxidized than the hydrocarbons of the body and hence is used up in preference to them while the excess of unconsumed carbonaceous matter in the body accumulates and is stored up chiefly in the liver and adipose tissues.

The most pronounced cases of fatty infiltration are found in the livers of those who suffer with ^{infiltrating} pulmonary tuberculosis. The probable explanation of this is that the diseased lung is insufficient for thorough oxidation within the system and in consequence the fat accumulates. Why the liver should be chosen for the storehouse for fat and not other portions of the body is not as yet understood.

PATHOLOGICAL ANATOMY.— The liver which is infiltrated with fat is uniformly increased in size. Sometimes this increase is enormous, the liver being several times its normal size. Although so large and in consequence as a whole much heavier than normal, pieces of tissue, cut away, and sometimes the entire organ, will float in water. Usually the border of the liver is smooth and sharp, though occasionally it is swollen and rounded. The capsule on account of the increased size is tense and glistening. In consistency, the organ is quite flabby. It usually pits on pressure the indentation remaining for sometime after the pressure is removed. On section the tissue is of a decided mottled yellow color. In the early stages the yellow portions can, with the naked eye, be seen to form rings about the periphery of the lobules, the central portions being normal in color. In more advanced cases the entire surface presents the same yellowish hue. The blood vessels usually contain less blood than normal and the tissue is quite friable.

PATHOLOGICAL HISTOLOGY. Under the microscope it can be seen that in the earlier stages the deposit of fat is confined to the periphery of the lobules. In rare cases there is also found a similar deposit within the cells about the central vein, the intermediate tissue being normal. Under the low power the droplets of fat will be found to vary considerably in size, the largest occupying the cells at the extreme periphery while the smaller ones are found farther within the lobule. Each drop appears as a bright spot, or clear space and upon focusing upon it one can see either a bright center with a dark border, or by changing the focus just the opposite. Under the high power, the liver cells which are loaded with fat will be found to have lost their polygonal shape somewhat. In some there will be found considerable granular looking protoplasm and only a few small droplets of oil, while in

others the several small drops seem to have flowed together into one large drop which now occupies nearly the entire

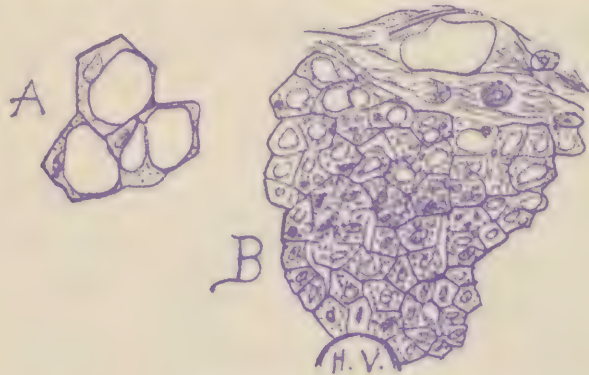


FIGURE 8.

- A. Group of fatty cells showing large fat drops pushing nucleus and protoplasm to one side.
- B. Portion of a lobule in fatty infiltration. Large fat drops in peripheral cells. Smaller ones towards centre. Normal cells about central vein.

cell pushing the protoplasm and the nucleus, which still stains well, to one side, where it appears flattened between the drop of oil and the cell membrane.

Even though fatty infiltration may at times be very extreme, if the cause be removed the organ will, provided the process be not too advanced, return to the normal. This is a point which marks an important difference between this condition and the other fatty change to which the liver is subject, i.e. fatty degeneration.

FATTY DEGENERATION.

DEFINITION: - A diseased condition of the liver in which the protoplasm of the liver cells, by a process of degeneration, becomes converted into fat.

ETIOLOGY: - Fatty degeneration is found in the livers of those who have died from such wasting diseases as tuberculosis, cancer, Addison's disease, Anaemia and the like. It is also the result of certain poisons, notably phosphorus and arsenic. It is the sequel of cloudy swelling and occurs often in those who have died of continued fevers.

It is impossible to make a sharp distinction between fatty degeneration and fatty infiltration although the two processes are distinct and differ in many respects, both when viewed with the naked eye, and when studied under the microscope. In the liver in which fat is frequently found normally, it is often practically impossible to determine whether a given case is one of infiltration or degeneration. The process differs from infiltration in that it is strictly one of death, of degeneration, of the liver cells. The fat seen within the cells is the resultant product of the death of the cell protoplasm and not an increased production of fat, or storage of fat within these cells. While from fatty infiltration the liver may recover if the cause is removed in time, from fatty degeneration there is no recovery. The protoplasm once changed into fat cannot be reconverted into protoplasm. The process ends finally in the complete death of the cell which becomes converted into a mass of fatty granular detritus.

PATHOLOGICAL ANATOMY: - The liver is reduced in size. For this reason it is sometimes spoken of as the atrophic fatty liver. When the wasting is pronounced the capsule is found to be dull, more or less opaque and wrinkled.

On section the color of the organ is yellowish, or yellowish brown and, as in fatty infiltration, this change can be frequently seen about the periphery of the lobules at first. The tissue is usually pale, friable and less firm in consistency than normal. Oil drops can be scraped from the surface.

PATHOLOGICAL HISTOLOGY: - Under the low power one can see that the liver lobules are fairly well outlined by a zone of fatty cells about their periphery. As a general thing these fat droplets are smaller than those seen in fatty infiltration, though in some cases, especially in phosphorus poisoning they are quite large.

Under the high power one sees that the droplets of fat are largest in the cells of the extreme periphery of the lobules. Here the liver cells are found to be shrunken and angular. In many places they have entirely degenerated, leaving nothing but a small mass of fatty granules. In other places cells are seen which contain several good sized globules of oil and whose protoplasm is very distinctly granular and stains poorly. No nucleus can be demonstrated in these cells. As we pass further toward the centre of the lobule the droplets become smaller and smaller and we meet with fewer degenerated cells. And there cells are seen which stain well and in which a nucleus can be found. Finally as we approach the central area, ^{more} and more healthy cells are met with, or cells showing only cloudy swelling, until just about the intralobular vein there is found a narrow zone of cells in which no fatty changes are seen. When the process is very advanced however the fatty changes occur throughout the lobules. The capillaries in such a liver are usually clearly defined and easily seen.

PHOSPHORUS POISONING: - Where the fatty degeneration is acute, as in cases of phosphorus poisoning, the liver is not diminished in size; it is pale usually everywhere, and may

show small hemorrhages in places. Here and there the tissue will have a very decided yellow color due to the ruptures of a small bile duct. The drops of oil found within the cells are large and more nearly like those seen in cases of fatty infiltration. This is because the process has been so rapid that there has been no time for absorption of the fat to occur.



AMYLOID DISEASE OF THE LIVER.

SYNONYMS:- "Waxy Liver", "Bacony Liver", "Lardaceous Liver", "Albuminoid Liver."

DEFINITION:- A disease of the liver characterised by the presence about the cells and in the walls of the vessels of the organ, of "a peculiar, foreign, solid substance having a composition identical with albumen." (Hamilton).

ETIOLOGY:- Amyloid disease of the liver is found associated with conditions of extensive suppuration, with pulmonary tuberculosis, caries, chronic syphilis and a few other diseases.

PATHOLOGICAL ANATOMY:- The liver affected with amyloid is increased in size and weight. This increase, in some cases is very marked, the organ being nearly double its normal dimensions. Its specific gravity is also increased. The tissue pits readily on pressure, but the depressions rapidly vanish when the pressure is removed, showing that it is quite elastic. Owing to the increased size of the liver its capsule is stretched, thin and translucent.

The color of the organ is paler than normal owing to the fact that the vessels contain very little blood. The cut section is of a greyish-yellow color and may in places show the characteristic appearance of fatty infiltration with which amyloid disease is frequently associated. The cut surface is also described as having "a peculiar dry lustre, comparable to that of a wax model."

PATHOLOGICAL HISTOLOGY:- When a typical case is examined with the microscope, the wax like substance is seen to be deposited in the middle zone of the lobule. As it is sometimes difficult to make out any liver cells, their place being

18

taken by the amyloid material. In the portal and hepatic zones the cells appear normal or slightly fatty. The amyloid substance which has been deposited around the cells in the middle zone presses upon them to such an extent that in time they atrophy and disappear. Examination of the small arteries and capillaries shows that there is here also an abundant deposit of the same substance, and it is probable that these structures are the first to become affected.

A diffuse form of this disease is sometimes met with in which the entire capillary net-work has become simultaneously affected. The wax-like material in these cases is deposited only about the vessels and not about the cells, which however are somewhat atrophied, because of the pressure brought to bear upon them. The atrophy is much less marked than in the other form of the disease.

For the methods of staining the Amyloid Material see Appendix.
For an account of the nature of the Amyloid Change, see Lecture Notes on "Amyloid Degeneration".

CIRRHOSIS OF THE LIVER

DEFINITION - A chronic disease of the liver characterised by an overgrowth of the connective tissue elements of the organ and a destruction of liver cells (Chronic Interstitial Hepatitis)

ETIOLOGY - The chief factors in inducing these changes in the liver may be summed up in brief as follows.

- 1 Alcohol. This is probably by far the most important agent in producing cirrhosis. Its undue use in a large number of cases must undoubtedly be considered the direct cause.
- 2 Syphilis. This disease ranks next to alcohol as a causative agent both the congenital and the acquired form frequently being associated with a distinct variety of cirrhosis.
3. The habitual use of highly seasoned foods.
4. Long standing chronic passive congestion of the liver. This is however doubted by some authorities, (i.e. Hamilton).
5. Prolonged malarial poisoning
6. Scarlet and typhoid fevers
7. Pickets
8. Anthracosis. With pronounced cases of this disease there has been noted, especially by Welch, a form of cirrhosis associated with a considerable coal dust pigment in the liver.

The disease is essentially one of middle and advanced life though a certain number of cases occur in children.

VARIETIES - Two main forms are met with known respectively as the Atrophic and the Hypertrophic. Minor varieties are also found, chief among which may be mentioned Fatty Cirrhosis and Perihepatitis.

ATROPHIC CIRRHOSIS

SYNONYMS: - "Hobnail" Liver, "Small Cirrhotic" Liver, "Course Cirrhosis", "Sow-drunkers" Liver, "Polylobular Cirrhosis", "Alcoholic Cirrhosis".

PATHOLOGICAL ANATOMY: - As the name atrophic indicates the liver is found at autopsy to be considerably reduced in size, frequently not being of more than one half its normal proportions, its weight also being correspondingly diminished. The organ is not infrequently deformed, and its surface presents numerous elevations and depressions which vary considerably in size and shape, giving to this condition the name of "Hobnail Liver". The capsule appears to be thickened, especially at the bases of the depressions just mentioned. The organ is firm to the touch, is tough, tears with difficulty, is quite inelastic and feels very much like a piece of soaked leather. On section the color is usually distinctly yellowish, (from which the name Cirrhosis - yellow) though occasionally it is of a reddish hue.

The liver cuts with comparative difficulty, and upon closely examining the cut surfaces one can see that the tissue is everywhere beset with connective tissue, which, running here and there cuts up the organ into many irregular sized masses of liver cells. If the section has passed through one of the superficial depressions bands of fibrous tissue can be seen running from its base into the liver substance in all directions. It is owing to the contractions of these bands that the superficial pits are due.

In the very earliest stages of this condition the liver may be slightly increased in size, due probably to the hyperaemia present at this time.

PATHOLOGICAL HISTOLOGY: - When carefully studied under the microscope it will be seen that the superficial layer of the capsule is very little, if any thickened. The deep layer

however, that portion which is continuous with Gleason's capsule will be found to be many times its normal thickness, especially at the bases of the superficial depressions, from which one

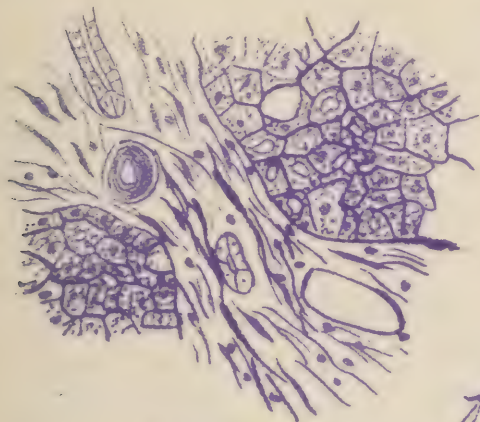


FIGURE 9.

Atrophic Cirrhosis

Showing band of connective tissue cutting up the liver substance. Liver cells slightly fatty

can now clearly see bands of fibrous tissue running into the liver substance. These soon divide, subdivide and re-unite, forming in this way a coarse net-work in the meshes of which lie masses of liver cells of varying size. These main bands of cicatricial-like tissue are well defined and only occasionally can be seen to send off fine fibrils between the cells of the lobules. This is held by many to be a distinctive characteristic of this form of cirrhosis. About all the portal systems also the connective tissue is increased and from these it runs

in broad bands into the liver substance in every direction.

If we examine, under the high power, the margins of these well defined bundles of connective tissue, we will see that certain changes have been going on in the liver cells which lie next them. These changes are all atrophic and result in the ultimate destruction of these cells. As the fibrous tissue increases and invades successively more and more of the parenchyma, numbers of liver cells are, as it were, shaved off from the lobule by the advancing growth and become enveloped in its meshes. Here after a time, owing to the constant pressure which is exerted upon them, they soon begin to decrease in size until finally they present no resemblance to a liver cell whatever and lie some distance from the edge of the lobule. They ultimately entirely degenerate and disappear. Farther within the lobules the cells, in many cases, will be found to be in a state of fatty infiltration. Other changes can sometimes be made out with the high power. These consist

chiefly in the enlargement of certain liver cells and of their nuclei which then proceed to divide and to subdivide, becoming in this way smaller and smaller. On the other hand in the majority of cases, instead of this proliferation of liver cells, the nuclei of many of the cells will be seen to have enlarged somewhat and then instead of proceeding to divide, retrogressive changes set in resulting in the formation of a vacuole within the nucleus and the final degeneration of the cell.

ORIGIN OF THE CONDITION:—For many years it was thought that the process of connective tissue increase in these cases of cirrhosis was a primary one, which started because of some action of the supposed cause. This increase in the fibrous elements of the organ lead naturally to the destruction of the proper cells of the part, as has just been described, by pressure. Of late however, it would seem that this view must be modified somewhat, and although we must recognise that when the fibrous tissue has once formed, it will produce an atrophy of liver cells because of its constant pressure, we now look upon the increase in connective tissue as a secondary process, following upon some primary disease of the liver cells, causing them to degenerate, their place being taken by a new growth of connective tissue in the same way that in an extensive wound, which the proper tissue of the part is unable to repair, this tissue enters and fills up the space.

Whether the process be primary or secondary, however, the new tissue is derived from that which is already in existence in the portal system and supporting structure of the organ, although Plesch, Hamilton and some others have described the formation of connective tissue from the proper liver cells by the process of enlargement, division and subdivision already mentioned as being noticed in a very small number of cases.

CIRRHOSIS

HYPERTROPHIC CIRRHOSIS

SYNONYMS: - "Large Cirrhotic Liver" "Fine Cirrhosis" "Biliary Cirrhosis" "Monolobular Cirrhosis" "Granular Liver" "Hyperplastic Fibroid Induration"

PATHOLOGICAL ANATOMY: - The organ is enlarged, at times weighing as much as 7 to 9 pounds. This enlargement has led to the term Hypertrophic Cirrhosis, which though it is ⁱⁿ constant use, is in fact misapplied, because on microscopic examination, as we shall see in the next paragraph, the proper liver cells are found to be in a state of atrophy and degeneration, while the enlargement of the organ is due to an increase in the interstitial tissue more rapid than the destruction of the liver cells.

The surface of the liver, which in the early stages is smooth, becomes, as the disease advances and the new formed fibrous tissue shrinks, somewhat finely granular in appearance. The liver tissue is firm, dense, even hard at times and tears with ease. In the majority of cases the surface shows yellowish or greenish patches, which when the organ is sectioned can also be seen scattered through its substance. This discoloration is due to the absorption of bile by the liver cells. Here and there throughout the liver substance run numerous fine bands of connective tissue which cut it up into small lobular shaped masses. The capsule is very little, if any, thickened. The fibrous tissue in the portal

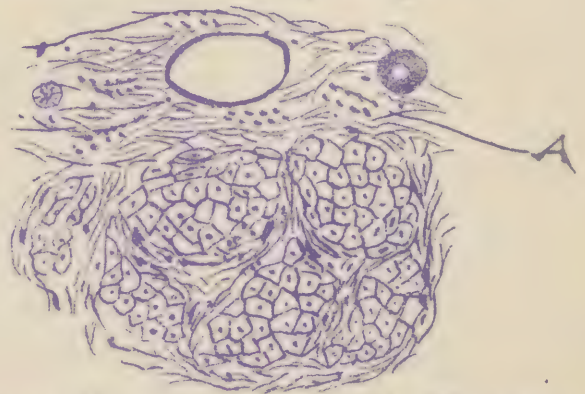


FIGURE 10. - Hypertrophic Cirrhosis

Portion of a lobule and portal system showing the increase in the bile ducts (A) and the invasion of the lobule by fine bands of connective tissue

The fibrous tissue in the portal

24

systems is increased in amount, and occasionally the portal veins seem to be dilated.

PATHOLOGICAL HISTOLOGY: When examined microscopically fine bands of connective tissue are seen to traverse the section in all directions. These, it will be noted, lie about the periphery of the lobule surrounding them on all sides. This condition is made out with especial ease in the earliest stages, in some cases the lobules being so well marked out that the section resembles closely that of a pig's liver. The new growth of fibrous tissue, as in Atrophic Cirrhosis, begins in the portal systems, chiefly about the bile ducts, and from here grows out into the interstices between the lobules from these main bundles, which are much smaller than in the atrophic variety, smaller bands pass into the lobules between the liver cells, and by the pressure which they exert cause them to atrophy and degenerate. Like atrophic cirrhosis this variety advanced by exacerbations, and if the section be from a liver in which the process is actively advancing one will find in and about the portal systems and the larger bands which run between the lobules, a certain amount of proliferation of connective tissue cells, the young cells appearing as masses of small round bodies with deeply staining nuclei.

In cases where the disease is, so to speak quiescent, these masses will not be seen, the new cells having grown out into fully developed connective tissue corpuscles.

BILE DUCT STRUCTURES: - Embedded in the new-formed connective ^{tissue}, especially in those cases which are somewhat advanced, there will be found numerous double rows of nuclei. These represent minute bile duct like structures. Sometimes they can be seen following the finer bands of fibrous tissue into the substance of the lobule, and again within the lobule one will occasionally see a few similar structures. According to Hamilton, these are formed in the following manner. First

bands of connective tissue growing into the lobule surround double rows of liver cells. When this happens the cells so enclosed become smaller and smaller until nothing is left of them but their nuclei and a little protoplasm. When the specimen is injected through the biliary system these structures are found to be connected with the main bile ducts. From this fact he argues that the rows of liver cells in the normal liver are to be regarded as essentially expansions of the bile duct epithelium, and that in this form of cirrhosis they revert to their bile-duct-like embryonic condition. When the disease becomes very far advanced, these structures, to a certain extent disappear. Occasionally cases of hypertrophic cirrhosis are met with in which there appears to be no new formation of bile ducts.

FATTY CIRRHOSIS.

In both the Atrophic and Hypertrophic variety we frequently find that the cells of the liver are in a state of fatty infiltration. In cases of typical fatty cirrhosis however the organ is not reduced in size, but is somewhat larger than normal. In consistency and color it very much resembles an ordinary fatty liver. The capsule is smooth and glistening, though occasionally it may be slightly granular in appearance. The liver is firm and cuts with some difficulty, and when examined microscopically, there is seen to be not only an extensive deposit of fat within the liver cells, but also an extensive formation of connective tissue throughout the organ.

CIRRHOSIS.

ATROPHIC

1. The liver is decreased in size.
2. The surface of the organ is roughened with projections of considerable size. The capsule is quite thick.
3. There is little or no attempt at new bile duct formations.
4. There is little or no bile staining of the tissues.
5. The bands of connective tissue are coarse and enclose various sized areas of liver cells.
6. The increase of connective tissue in the portal canals by compressing the smaller branches of the portal veins causes a congestion of the portal system in the abdomen and causes ascites.

HYPERTROPHIC

- The liver is increased in size.
- The surface of the organ is but slightly roughened, is rather granular in appearance. The capsule is rarely thickened.
- New bile duct formation is characteristic of this condition.
- The tissues are frequently discolored by bile.
- The bands of connective tissue are fine and surround individual lobules, sending finer bands into them.
- The new formed connective tissue compresses the bile ducts more than it does the portal veins and therefore causes a retention of bile and a consequent jaundice but not ascites.

CIRRHOSIS.

PERIHEPATITIS.

SYNONYM: - "Eliasson's Cirrhosis".

In this condition the liver is greatly reduced in size and before death can not be diagnosed from the ordinary

atrophic variety of the disease. At autopsy not only is the reduction in size notable, but there may also be considerable alteration in shape. Two forms are met with. In one the capsule of the organ is very much thickened, tough and of a cartilaginous consistency. It is usually very firm and greyish-white in color. When this is stripped off, which can be done easily, the liver substance beneath looks normal, but when examined carefully generally shows some cirrhotic changes.

In the other form the capsule is very little altered, the increase in connective tissue being confined to the portal systems chiefly, and showing little tendency to involve the liver substance.

The over-use of alcohol is the most common cause.

ACUTE INTERSTITIAL HEPATITIS

DEFINITION: - An acute inflammatory condition of the liver affecting particularly the fibrous tissue elements of the organ.

ETIOLOGY: - Acute interstitial hepatitis is most frequently associated with cases of small-pox, scarlet fever, measles, typhoid fever, or the other specific fevers, and is found also in the early stages and during the exacerbations of the various forms of cirrhosis.

PATHOLOGICAL ANATOMY: - In size, the liver, if altered at all is slightly increased owing to the congestion which is always present. Upon section of the organ blood escapes freely, and when the cut surface is examined closely small grayish or red translucent spots can be seen here and there. Besides these changes there is nothing of note to be observed.

PATHOLOGICAL HISTOLOGY:- Cloudy swelling (see back) is always found in this condition, especially if the patient has died of one of the specific forms. In the portal canals, particularly, and at times in the fissures between the lobules where there is a slight amount of connective tissue, numerous small round cells are seen. These are chiefly the result of a proliferation of the connective tissue, though some of the cells may be leucocytes which have migrated from the vessels. It is these small masses of cells which give rise to the gray gelatinous points noted in the liver at autopsy.

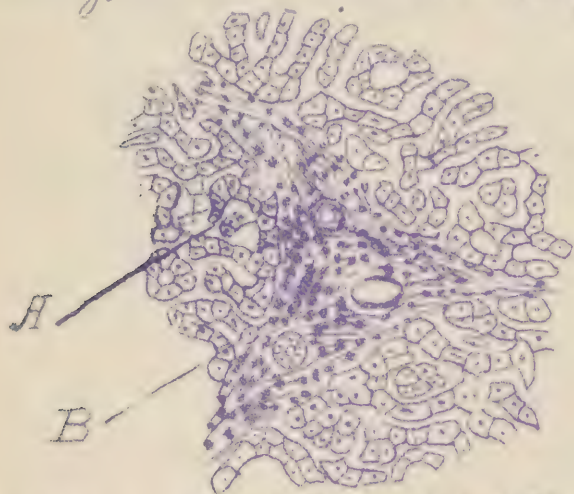


FIGURE 11. Acute Interstitial Hepatitis

A. Normal liver tissue B. Interlobular connective tissue infiltrated with small round cells.

We have in these cases, evidently the beginning of a cirrhotic process. Most of the small cells with deeply staining nuclei are young proliferated tissue cells which in time develop into fully formed fibrous tissue and bring about the changes so characteristic of cirrhosis.

A similar picture is seen in cases of early acute abscess formation, but here the cells instead of going on to the formation of connective tissue, degenerate, probably because of the presence of pyogenic (pus producing) organisms.

SYPHILITIC DISEASE OF THE LIVER.

Syphilis affects the liver chiefly in two ways which differ markedly from each other. These will be described under

I. Congenital Syphilitic Cirrhosis; and

II. Syphilitic Gumma of the liver.

(CONGENITAL SYPHILITIC CIRRHOSIS.)

This form of the disease is met with in still-born syphilitic infants and also in those who have died in childhood with other signs of congenital syphilis about them. Some cases are on record in which, although there were no symptoms of syphilis, the autopsy disclosed this condition of the liver.

PATHOLOGICAL ANATOMY:- At autopsy the liver is either noted as normal in size, or as slightly enlarged. In fact, so slight may be the gross changes, that without further examination the organ might be considered normal. In other cases, beside the slight enlargement the surface may be slightly discolored, or there may be a few nodular projections here and there. In consistency the tissue is firm and tough and in color usually somewhat pale in spots.

On section in mild cases no changes may be noted, while in others it will be difficult to make out in places, anything of the normal structure.

PATHOLOGICAL HISTOLOGY:- When examined microscopically very definite changes can be seen. In the milder grades of the disease the liver tissue will be found to be beset with numerous small round cells. The interlobular tissue is usually the most affected, though infiltrated patches lying within the lobules are not uncommon. The aggregation of these small round cells is also seen within and about the

capillaries. When the disease is more grave further destructive changes are found. The whole organ or numerous areas throughout its substance are seen to be the seat of new-formed connective tissue. This is not confined to the portal systems, nor does it extend in well defined bands, as in the varieties of cirrhosis already described, but follows the capillary net work of the lobules throughout. The liver cells as a consequence of this are found to be separated one from another by fine translucent fibrous tissue and on account of the pressure exerted by this to have assumed all sorts of shapes and sizes. They are in fact in a state of extreme atrophy and degeneration. The new formed tissue does not look like that seen in the ordinary forms of cirrhosis, but is of a finer texture and more translucent. It arises not only from the pre-existing connective tissue of the organ, but from the endothelial cells which line the capillaries and lymphatic spaces as well. On account of the proliferation of these cells we have the small round cells called infiltration noted in the earlier stages and ultimately, when the new tissue is fully developed, an occlusion of many of the capillaries (endarteritis obliterans) and lymph spaces which lie at the margins of the lobules and extend into them between the liver cells and interlobular capillaries.

SYPHILITIC GUMMATA OF THE LIVER.

Syphilitic gummata may occur either as an evidence of congenital syphilis, or as a tertiary lesion of the acquired disease. Like syphilitic disease elsewhere all the lesions tend to the production of new connective tissue in which subsequently degenerative changes take place. Gummata of the liver, as this condition is sometimes called, is therefore closely allied to the diffuse congenital cirrhosis just described. In the present form however the new fibrous tissue is much coarser in quality, and here and there tends to fall into gummata decay.

31.

PATHOLOGICAL ANATOMY: - The liver affected with this disease is very frequently much altered in shape and size, so much so at times that all resemblance to the normal organ is lost. More frequently however the liver is but moderately distorted and presents here and there pronounced ridges and depressions, or pale depressed scar-like notches.

The capsule is usually thickened and shows evidences of previous inflammation in numerous adhesions to adjacent parts which are either old and fibrous or still fibrinous and easily broken.

Upon section of the organ, in many places wide bands of cicatricial-like tissue can be seen running in from the capsule, and scattered throughout the substance of the liver there will be found nodules of varying size. If the disease be in an early stage these will be greyish in color and pale, but when older they may be described as "pale yellowish, cheese-like nodules of irregular outline, surrounded by a fibrous zone the outer edge of which loses itself in the lobular tissue, the lobules dwindling gradually in its grasp. This fibrous zone is never very broad; the cheesy centre varies in consistency from a jelly-like toughness to a pulpy softness; it is sometimes mortar-like from caseous change." (Wilkes.) The deformity sometimes noted in the organ is produced by the gradual healing of these gummata.

PATHOLOGICAL HISTOLOGY: - It will be best to describe the minute anatomy of the young developing gummata and of the older gummata masses separately.

The younger gummata are chiefly found in the livers of syphilitic children, either still-born, or dead of the disease, or of some intercurrent affection.

On examining a nodule taken from a liver of this kind, it is seen that the growth is situated in newly formed intra-lobular fibrous tissue; in other words that the formation of a gumma is preceded by a syphilitic cirrhosis identical with that

Already described (on back); at certain points the development of fibrous tissue has taken place to such an extent that there are numerous strongly marked fibrous bands intersecting the lobules and cutting up the liver tissue. These fibrous bands are highly vascular, vessels in all stages of development being seen in their substance. In the fibrous band and around the vessels the first trace of the developing gumma appears in the form of deeply stained embryonic cells (small round cells), forming a ring which gradually increases in diameter; as this extends peripherally, the cells near the centre become angular, granular, atrophied, and with their nuclei stain poorly. (Woodhead).

The gumma just described is an actively growing mass of connective tissue. All the important changes however are not confined to this mass alone. If we examine the vessels in the neighborhood we will find that their coats have become thickened, chiefly through an increase in the thickness of the intima, or inner coat. On account of this thickened condition the lumina of the vessels are at times completely obliterated. Where they are still pervious so far as the thickening is concerned, they will in many instances be found to be plugged with a firm coagula.

In older gummata, under the high power the changes which have taken place can be made out with greater distinctness. These may be briefly summed up as follows:

1. In the centre of the mass nothing but granular, degenerating, atrophic, cells.
2. Surrounding these a zone of large cells similar to the cells described as "epithelioid" in speaking of the structure of a tubercle. They are probably the same.
3. About the margins of the mass a certain amount of fine connective tissue.
4. Outside of this a zone of small round-celled infiltration.

33

Gummata which have reached a certain size almost invariably undergo caseation which is probably due both to the specific action of the syphilitic poison and to the obliterating end-arteries which is going on in the vessels, by which the blood supply is gradually cut off.

THE LIVER LESIONS IN TYPHOID FEVER

Although the chief lesion of typhoid fever is found in the intestines (see Typhoid Ulcer of the Intestines), other parts show certain changes and the liver is usually affected in the following way.

PATHOLOGICAL ANATOMY:- In the early stages of the disease it is hyperaemic, and in a large proportion of cases is somewhat swollen. In color it is paler than normal and the cut section looks granular and turbid. Scattered throughout the substance of the organ may be seen numbers of small spots, greyish in color and about the size of a pin's head. These resemble somewhat the small tubercles found in the liver. In a small percentage of cases abscesses may be found, and acute yellow atrophy is extremely rarely met with.

PATHOLOGICAL HISTOLOGY:- Beneath the microscope the small greyish spots just mentioned are found to lie chiefly in the zone of the hepatic artery, though in advanced cases they spread rapidly and are found also in the zone of the portal vein (peripheral zone) as well. These minute nodules are composed of necrotic liver cells in all stages of disintegration. It has been supposed that they were caused by the impaction of masses of bacteria within the lobular capillaries of the intermediate and peripheral zones, but Reed working under Welch, has made a careful study of this lesion and can find no relation between these areas and the bacterial infection. Hamilton also states that he has been unable to detect any bacteria within the necrotic nodules.

Ultimately the necrotic cells fall to pieces leaving only a small circumscribed mass of granular and fatty detritus. Aside from these local lesions the liver cells show wide spread cloudy swelling, and in many cases well marked fatty degenerations (see back, Cloudy Swelling and Fatty Degenerations).

LEUCOCYTHAEMIA

SYNONYM: - Leukaemia

DEFINITION: - "An affection characterised by persistent increase in the white blood corpuscles, associated with enlargement either alone or together, of the spleen, lymphatic glands, or bone marrow" (Osler.)

ETIOLOGY: - Nothing is known as to the cause of this condition. (For further details see any work on the practice of medicine.)

While the chief pathological conditions are to be found in the parts above mentioned the liver also shows certain changes which are worthy of mention.

PATHOLOGICAL ANATOMY: - This organ is usually enlarged. In one case described by Welch it weighed over thirteen pounds. In consistency it is firm, its surface is smooth and pale. Beneath the capsule there may be small bright hemorrhages. When the organ is cut, the surface is seen to be paler than normal. This is most marked in the interlobular fissures giving to the section the appearance of a "network, or irregular veining of pearly white color."

PATHOLOGICAL HISTOLOGY: - When studied microscopically the columns of liver cells are seen to be widely separated "by leucocytes, which are partly within and partly outside the lobular capillaries." These leucocytes appear as small round cells with deeply staining nuclei. Sometimes they are found aggregated in little clumps, most frequently in the peripheral zone, and when occurring in this manner they obscure the liver cells. When studied with the high power a few delicate threads of fibrin may be seen in places.

In some cases pigmentation of the liver cells is found which, though it differs from the pigment found in cases of passive congestion is rather less pronounced in character and is probably derived from the blood.

TUBERCULOSIS OF THE LIVER.

Tuberculosis affects the liver in two different ways, namely as a milinary tuberculosis and as a tubercular perihepatitis; this is to say that it affects two different parts, the liver substance and the capsule of Glisson. Frequently the one condition is present to the entire exclusion of the other, and the former is much more common than the latter.

MILINARY TUBERCULOSIS.

PATHOLOGICAL ANATOMY - At autopsy there are, in the majority of cases no gross evidences of the disease. In other cases upon section one may see small greyish nodules scattered throughout the liver substance, which are most numerous in the neighborhood of the capsule. When the disease is but little advanced these nodules may be so small as to be invisible but they ultimately increase in size, become non-vascular, caseous and bile-stained, so that upon section they now appear as yellowish points.

This form of the disease is in nearly every case secondary to advanced tuberculosis of the lungs, or is part of a general milinary tuberculosis. It rarely if ever occurs as a primary affection. From the tuberculous lesions in the lungs the tubercle bacilli enter the circulation and lodge in the capillaries of the liver lobules.

PATHOLOGICAL HISTOLOGY:- The liver is the best organ in the body on which to study the growth and development of tubercles as well as their structure when fully developed. Where the process is not complicated by secondary catarrhal changes such as are met with in the lung and which mask to so great an extent the normal process of growth.

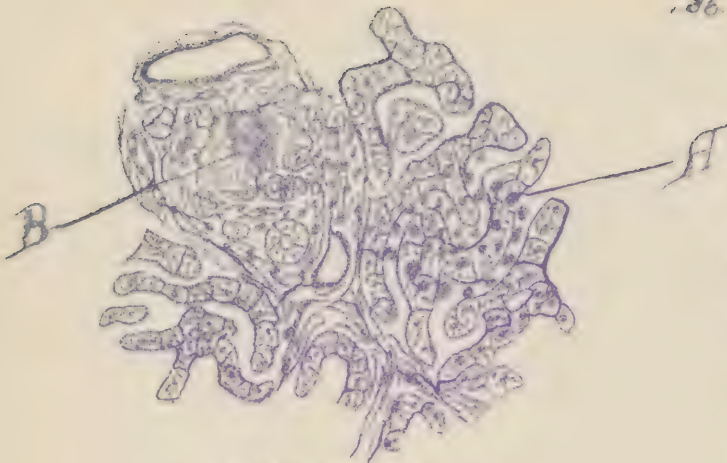


FIGURE 12.

Miliary Tuberculosis of the Liver

A Young tubercle B. Tubercle just beginning to become caseous

In its earliest stage the tubercle of the liver is seen to be simply a mass of small round cells with deeply staining nuclei lying about the liver cells in a small circumscribed area. These cells are probably the result of proliferation of the fixed connective tissue cells and of the endothelial cells of the part, and their presence is due to the stimulating effect of

the tubercle bacilli which have become lodged in the capillary vessels of the part. After a short time there is added to this little group a number of cells which, because of the inflammatory reaction set up by the bacilli, have migrated from the vessels. When examined in this stage with the high power we find that the tubercle is made up simply of migrated leucocytes, or lymphoid cells and of proliferated cells, many of which have already increased somewhat in size and show a distinct vesicular nucleus, the epithelioid cells as they are called. The liver cells of the affected area at first show no changes, but before long they become shrunken and granular and finally disappear.

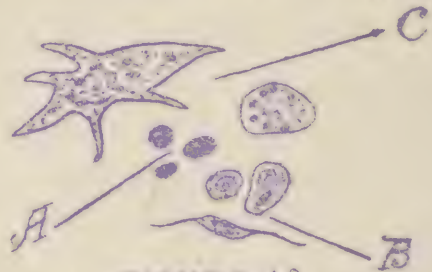


FIGURE 13.

Types of Cells found in Tubercle

A Lymphoid B. Epithelioid C. Giant Cells

If we examine a later stage, after time enough has elapsed for the tubercle to reach its full development and to begin to show retrogressive changes, a different picture is presented. The nodule is now of considerable size and is sharply defined. At its centre we find all the cells in a necrosed condition,

appearing as a granular indefinite mass which is frequently bile-stained. About the margins there is a narrow zone in which the cells are dying, their protoplasm presenting a granular poorly stained appearance and their nuclei appearing as fine broken up fragments, (fragmentation of the nuclei). About the border we still find the same cells described as composing the young tubercle, and somewhere within the mass will be seen one or more large cells containing many nuclei, the giant cells. These are usually described as occupying the centre of the tubercle, but one finds them fully as often somewhere about the periphery of the mass. Running through the nodule and about its margins can be clearly seen fine delicate fibrils of connective tissue.

All liver cells have now entirely disappeared from the tubercle, and those about its borders appear flattened and granular. In some cases these older tubercles break down and form small cavities with sharply defined walls, containing a yellowish or greenish, bile-stained detritus.

These miliary tubercles most frequently spring up in the hepatic artery zone of the lobules and rapidly spread into that of the portal vein. They at times enclose small bile ducts which probably accounts for the bile staining so frequently seen.

TUBERCULAR PERIHEPATITIS.

This form of the disease is most frequently associated with tubercular peritonitis, though both may frequently be dependent upon pulmonary tuberculosis. The lesion is characterised by a considerable increase in the connective tissues of the organ, especially in the portal systems and in the capsule. This increase frequently takes on the appearance of an atrophic cirrhosis, and the tubercles instead of being found in the substance of the organ are confined to the

areas in which there is connective tissue, i.e. in the capsule and in the portal spaces. These tubercles like those in the substance of the organ are at first small greyish nodules, ultimately becoming larger, yellow and bile stained. After reaching a considerable size they break down and form cavities which contain a semi-fluid, greenish detritus. In very rare instances the entire organ may be honey-combed by these cavities, which vary in size from that of a pea to that of a pigeon's egg.

Histologically these tubercles are identical with those already described.

ABCESS OF THE LIVER

There are three chief forms of hepatic abscess one of which only we will consider here. These are abscesses due to tropical dysentery; the pyaemic abscess of the liver, and suppuration in connection with hydatid cysts.

PYAEMIC ABCESES.

ETIOLOGY:- These are quite rare unless there be suppuration somewhere within the area of distribution of the portal vein, such as putrid ulcer of the stomach or intestine, septic disease of the pelvic organs, etc. In these conditions there is absorption of septic material from the original seat of the disease by the branches of the portal vein which carry it immediately to the liver.

PATHOLOGICAL ANATOMY:- In consequence of this mode of infection the abscesses are multiple and widely distributed. When lying near the surface the tissue over them is less firm in consistency than normal and frequently fluctuation may be obtained. Upon section of the organ numerous cavities are met with scattered throughout its substance which vary in size from that of a large pin's head to that of a hen's egg. In some instances several of these cavities will have become confluent forming a large sacculated excavation. The walls are ragged and sloughy, and the contents are frequently foul in odor and of a greenish yellow color. The surrounding tissue is usually soggy and pale in color.

PATHOLOGICAL HISTOLOGY:- The walls of these abscesses are found to be infiltrated with numerous small round cells and these are also found in considerable numbers around the vessels in the immediate neighborhood. The edges

40.

of the walls themselves as previously mentioned are raised and portions of necrotic tissue, which takes the stain very poorly can be seen projecting into the cavity. The contents are seen to be made up of pus cells in all stages of necrosis and disintegration. If the specimen be stained for micro-organisms (See appendix) these will be found as bluish, or violet stained masses in the clots in the vessels and in the capillaries. The liver cells in the neighborhood of the abscess are granular and in some instances completely degenerated and broken down into a granular mass.

PIGMENTARY INFILTRATION OF THE LIVER

Pigmentation, or pigmentary infiltration of the substance of the liver is a condition not infrequently met with. When it is considered that the circulation within the liver capillaries is very slow and that in consequence any foreign particles afloat in the blood are readily deposited it will be easily seen why this is so. If, as frequently happens, there are large numbers of disintegrated red corpuscles in the blood, these, or the colored iron compounds, which have been set free by the disintegration, soon come to be deposited within the liver. These first lodge in the capillaries of the interlobular connective tissue, and later in the vessels of the peripheral zone of the lobules. After a time they may escape from the vessels and appear in the connective tissue and within the liver cells themselves. The condition though common is not usually so extensive as to interfere with the functioning of the organ, though occasionally such masses of pigment are met with that the liver cells are obscured in places. The pigments derived from the blood are either yellow, brown or black, and the color imparted to the tissue varies accordingly.

At times the pigmentation will be so regular as to outline the lobules very well.

Biliary pigmentation is of a different nature, and being distributed in an entirely different manner will be found in different situations, generally extensively distributed within the liver cells throughout the lobules. This biliary pigmentation may be present to quite a marked degree in the liver, even though during life the patient was not jaundiced. The color of the bile pigment is usually of a bright yellow and occurs as very fine granules within the liver cells.

THE SPLEEN.

For a full account of the normal anatomy of the spleen read Piersol's or Schaffer's Histology, or Gray's or Quain's Anatomy.

AMYLOID DISEASE.

VARIETIES - The Spleen is more often affected with amyloid disease than any of the other organs. It here appears in two forms which are usually described as the "Sago-Spleen" and as the "Diffuse Waxy Spleen."

The first variety is by far the most common and will be first described. By staining these two varieties of this disease the normal structure of the spleen is quite clearly shown and for this reason amyloid disease is here described first among the few splenic diseases that we will study.

SAGO-SPLEEN.

PATHOLOGICAL ANATOMY - The organ is generally enlarged and may weigh as much as 40 ounces. In consequence of this enlargement, the capsule is somewhat stretched. In consistency the spleen is firm and on section the tissue is usually found to be dryer than normal and quite friable. On closely examining the section with the naked eye one can make out the Malpighian bodies with great ease. They appear much larger than normal and of a pearly yellowish color, that resembles the appearance of boiled grains of sago, (whence the name). These bodies are usually rendered more prominent because of the dark red color of the surrounding splenic tissue. If we apply a solution of iodine to the cut surface these Malpighian bodies take on a mahogany red color.

43

PATHOLOGICAL HISTOLOGY:- Both stained and unstained sections should be studied. In the unstained sections the Malpighian bodies which are the seat of the amyloid deposit are seen to be glistening, translucent, hyaline in appearance and of a yellow color. In the stained sections, when haematoxylin and eosin has been used, the same bodies have a peculiar bright pink color. All the lymphoid cells which compose these bodies normally have vanished and only here and there can one see a few scattered elongated nuclei stained blue. In the centre of the mass the central artery can still be seen.

About these amyloid Malpighian bodies the splenic pulp at first sight appears to be unaltered. If however a section be stained with gentian-violet which gives to the waxy material a beautiful pink color, a few reddish lines and dots can be made out here and there. These are sections of small vessels in the walls of which waxy material exists. Under the high power these amyloid vessels can be very easily studied and it is seen that the foreign material is confined to their middle coats. Usually in this form of the disease one also finds a very slight deposit of the amyloid material in the ^{interstitium} of the splenic sinuses immediately about the affected Malpighian bodies.

DIFFUSE WAXY-SPLEEN.

PATHOLOGICAL ANATOMY:- This condition has been described by some writers as simply an advanced grade of the saggy-spleen, but this is probably not the case as the waxy material is deposited in quite different localities.

As in the former case the organ is enlarged, though the enlargement is here usually more marked. In consistency it is quite firm and elastic and its edges are rounded. The cut section has a dry, glistening appearance, but no such

44.

"sago-like bodies as have just been described can be seen. If iodine solution be poured upon the cut surface the general color becomes a mahogany red, while the Malpighian bodies can be seen as minute yellowish spots.

PATHOLOGICAL HISTOLOGY:- Unlike the sago-spleen we see in this condition, when the section has been properly stained, that the Malpighian bodies are quite normal in appearance. The splenic pulp is however altered, and upon closely examining this we see that the wax-like material has been deposited in the wall of the splenic sinuses. One also finds that the same amyloid material exists in the walls of the arteries and small vessels in the Malpighian bodies. If these bodies are in any way altered it is by fibroid change, or by atrophy the wax-like material being deposited in other parts. Upon examining the splenic sinuses with the high power one can frequently see, that not only has the amyloid material been deposited in their walls, but that the cells which line them are in many places in a state of fatty degeneration.

CHRONIC PASSIVE CONGESTION OF THE SPLEEN.

DEFINITION:- A condition of overfullness of the spleen with venous blood due to some interference with the outflow of blood from the organ.

ETIOLOGY:- Valvular lesions of the heart, cirrhosis of the liver, emphysema, and fibroid conditions of the lungs all are associated with congestion of the spleen. (Describe on the opposite page the way in which ordinary cirrhosis of the liver produces passive congestion of the spleen.)

PATHOLOGICAL ANATOMY:- The organ is usually somewhat enlarged. It is heavier than normal and is fleshy in consistency. As a usual thing the capsule is thickened and in places may have a cartilaginous consistency. In color the spleen is dark red and when cut bleeds freely.

PATHOLOGICAL HISTOLOGY:- As the name of this condition would imply the chief thing noticed when the section is studied under the microscope is the great distention of all the sinuses with blood. Upon more carefully examining the specimen one finds that the trabeculae are thickened and more prominent than normal and that there is an evident increase in the connective tissue of the organ generally. This increase takes the form of fine fibrils of fibrous tissue running through the Malpighian bodies, which are less prominent than normal, and through and about the splenic sinuses. The cells which line these sinuses are also in many places seen to contain altered blood pigment, and occasionally one sees large leucocytes similar to those seen in passive congestion of the lung which seem to be loaded with small granules of a light brown pigment, which has been derived from the haemoglobin of broken down red blood corpuscles. About the vessels of the spleen in this condition there is also seen an increase in the connective tissue, and along the thickened trabeculae one can in places see small masses of small round cells very much like the masses of cells seen in granulation tissue. Within the thickened capsule and in some of the larger trabeculae one can ^{make} out a certain amount of hypertrophy of the muscle fibers.

TUBERCULOSIS OF THE SPLEEN.

ETIOLOGY. - Tuberculosis of the spleen, as with tuberculosis of all other parts is the result of the action of the tubercle bacilli. We never find this organ alone affected, that is it never occurs in the spleen as a primary affection, but is always found associated with tuberculosis of other parts.

VARIETIES. - Occurring in the spleen, tuberculosis is found in two forms, the one a miliary variety and part of a general acute miliary tuberculosis, and the other an extensive caseous tuberculosis, usually occurring with chronic tuberculosis of the lungs.

PATHOLOGICAL ANATOMY. - In the miliary variety the organ is but slightly altered in size or consistency, and upon section one can see very minute greyish points scattered everywhere over the surface. These are most numerous in and just beneath the capsule. Sometimes they are found to be slightly larger and to have a firm pink yellowish centre which indicates that caseation is beginning in these masses which are the minute miliary tubercles.

The second variety as has been mentioned is more chronic in character. Here upon section of the organ extensive yellowish, firm cheesy masses are found with sharply defined borders about which in the comparatively healthy splenic tissue one can frequently make out small greyish spots, the second crop of young tubercles. In this condition the organ is usually diminished in size and quite hard.

PATHOLOGICAL HISTOLOGY. - Under the microscope the miliary tubercles of the first variety are found to differ in no respects from miliary tubercles already described in other parts and will therefore not be described again here. (Write on the opposite page a description, and make a sketch of one of these miliary tubercles.)

LEUCOCYTHEMIA OF THE SPLEEN.

DEFINITION: - A condition associated with the general disease Leucocythemia.

ETIOLOGY: - Unknown.

PATHOLOGICAL ANATOMY: - In this condition one meets with the largest spleens found at autopsy. So great is this enlargement be that the organ may weigh several pounds. The increase in size occurs in all directions so that the shape of the organ is not lost. It is firm and tough and in color pale. Upon section the splenic tissue presents an indefinite appearance and is usually greyish in color with here and there a redder spot due to some small haemorrhage. The Malpighian bodies appear as grey points scattered over the surface.

PATHOLOGICAL HISTOLOGY: - Under the low power one can easily see that trabeculae are thickened and the Malpighian bodies somewhat enlarged, though in most cases the latter are not sufficiently altered to attract attention. Everywhere throughout the section there are large numbers of round cells, some of which are leucocytes while others are much larger and are of different origin.

Under the high power the changes in the trabeculae and the Malpighian bodies are more easily made out. Occasionally one can distinguish a fibroid condition of the latter. In the splenic pulp however the most noticeable changes are met with. Here the spaces are found to be distended and to be filled with cells, many of which are leucocytes, and many also larger cells which it can now be seen are derived from the cells which line these spaces. These lining cells are found to be swollen and enlarged and in many places to be attached to the walls by a pedicle, while others are found which have evidently just been detached. Most of these cells contain one nucleus, but some are found with two. In some cases they contain altered blood pigment. It will thus be seen that the changes in this condition chiefly occur in the pulp of the spleen and not in the Malpighian bodies as was once supposed.

In Pseudo-leucocythemia, or Hodgkins disease the chief changes occur in the Malpighian bodies and not in the splenic pulp, and the changes are thus not to be considered the same as is stated by some writers.

THE PANCREAS

CIRRHOSIS OF THE PANCREAS

This condition is stated by most authorities to be only very occasionally met with. It is probably of comparatively rare occurrence in any marked degree and upon what it depends is unknown. Those causes which are so prone to produce cirrhosis in other organs, such as the liver and kidney seem to affect this organ in a much less degree. Cirrhosis of the pancreas has of late been noted as occurring in a certain percentage of cases of diabetes. The present specimen is from a case of this kind.

PATHOLOGICAL ANATOMY:—But little can be said of the gross appearance of the organ in this condition. In general it is firmer than normal and cuts and tears with comparative difficulty. In some instances the development of connective tissue may be so great as to cause the organ to lose much of its normal shape when the new formed tissue contracts. This was the case in the pancreas from which these specimens were taken.

PATHOLOGICAL HISTOLOGY:—Upon microscopic examination of an area in which the cirrhotic changes are marked one finds that there has been a great development of connective tissue which not only surrounds the groups of glandular acini in wide bands but also invades these groups, small and large bands cutting them up into all manner of shapes and sizes. Fine fibrill of connective tissue run in between the acini and the subsequent contraction cause considerable atrophy, so that in some places little if any of the normal structure of the pancreas can be made out.

DIABETES AND LESIONS OF THE PANCREAS:-

That the pancreas is altered in many cases of diabetes is now a well known fact but no consistent lesion has as yet been discovered. Arteriosclerosis, cancer, atrophy, cyst formation and abrasion have all been described as occurring and it is a well known fact that total removal of the pancreas causes diabetes.

Reasoning from these facts it has been argued that the organ produces, besides its well known products, some other body of the nature of a ferment which has the power when taken into the blood of breaking up sugar. This ferment being absent the sugar is not broken up and is excreted by the kidneys as such. If only a small portion of the pancreas be left in the body diabetes will not follow.

LABORATORY MANUAL
— of —
Pathological Anatomy.

SECOND PART.

DISEASES OF THE LUNG.

CONTENTS:

<u>Emphysema</u>	Page 51
<u>Atelectasis</u>	" 54
<u>Pulmonary Oedema</u>	" 56
<u>Chronic Passive Congestion</u>	" 58
<u>Hæmorrhagic Infarction</u>	" 61
<u>Dust Pigmentation</u>	" 63
<u>Acute Pneumonia</u>	" 64
<u>Broncho-Pneumonia</u>	" 70
<u>Chronic Interstitial Pneumonia</u>	" 76
<u>Pulmonary Tuberculosis</u>	" 79
<u>Acute Pleuritis</u>	" 87

EMPHYSEMA

Two forms of Emphysema are recognised, the one spoken of as Interstitial, and the other as Vesicular.

INTERSTITIAL EMPHYSEMA

DEFINITION- This condition is characterised by the presence of air beneath the pleura and in the interlobular connective tissue.

Beneath the pleura little bubbles of air arrange themselves in rows like threads of beads, and in the interlobular septa they can be seen arranged in a somewhat similar manner. At times the pleura is dissected up over a considerable area forming in this way blebs of considerable size. Interstitial Emphysema should not be confounded with the post-mortem generation of gas in the interstitial tissue, which is not of infrequent occurrence.

ETIOLOGY- The causes of interstitial emphysema are such as will give rise to rupture of pulmonary alveoli, forming a communication between them and the interstitial tissue allowing in this way an escape of air from them into this tissue. Such a condition may be brought about by perforating wounds of the chest wall, or by injury to the lung by the end of a fractured rib. Violent coughing may lead to the same result, and for this reason it is sometimes found after cases of whooping-cough and bronchitis. The most favorite situation for this form of emphysema is the anterior borders of the upper lobes.

RESULTS- Two rare results of this condition are possible.

1. Capture of the sub-pleural blebs causing pneumothorax which may or may not be accompanied by pleuritis.
2. Passage of the air beneath the pleura to the root of the lung and thence into the tissues of the anterior mediastinum from whence it passes upward into the subcutaneous tissue of the neck and chest, giving rise to subcutaneous emphysema.

VEESICULAR EMPHYSEMA

DEFINITION - A disease of the lungs characterized by the dilatation of the pulmonary alveoli and infundibula frequently so great that rupture of their walls occurs, the condition being due "to persistent high intraalveolar pressure acting upon congenitally weak lung tissue" (Osler)

VARIETIES - Two main varieties are met with, the difference between them being due to a difference in their causes. These are known as Ideopathic, or Hypertrophic and as Compensatory Emphysema.

ETIOLOGY - Of these the first usually occurs as an independent affliction depending upon a variety of circumstances, while the second, as its name implies, is dependent upon the closure of a certain number of alveoli to air so that a greater amount is forced, at each inspiration, into those which remain open. Compensatory Emphysema is sometimes spoken of as Stenotic Emphysema.

Wherever there is consolidation of a portion of the lung there will be in the neighborhood areas of compensatory emphysema. Such conditions as pneumonia, tuberculosis, closure of a bronchial tube, etc. which are associated with consolidation, or in which air is not allowed to enter a certain number of lobules, are always associated with a certain degree of this condition.

Ideopathic Emphysema on the other hand is not dependent for its causation upon closure of areas of lung to the entrance of air. A large percentage of cases show a strong hereditary predisposition to this disease. Of etiological factors, the chief are, the playing of wind instruments, blowing glass, heavy lifting, etc. It must not be forgotten however that in the majority of cases there must be at the same time a weakened condition of the pulmonary tissue, otherwise we would expect to find this condition in all who follow the above callings. Bronchitis also plays a part as a causative agent, because of the cough which accompanies it.

53

Cohnheim taught that the congenital pulmonary weakness was probably due to a defect in the development of the elastic ~~fibres~~ in the alveolar walls.

PATHOLOGICAL ANATOMY:- The chest is usually somewhat enlarged and is more nearly circular than normal, the condition being spoken of as "barrel chest". On opening the thorax the lung margins are frequently seen to overlap one another, at times concealing the pericardium. The lungs themselves are larger than normal and occupy consequently more space in the chest cavity; they do not collapse when the thorax is opened, and when pulled with the finger do not resume their normal shape, their elasticity has therefore been impaired. In color they are lighter than normal, in many cases there being a notable absence of pigment, the condition being termed by Virchow "albinism" of the lung. When cut the knife passes through the tissue with difficulty. The organ has a "downy" feel and floats lightly on the surface of the water. The dilated alveoli can frequently be readily seen. When some of these have broken into a single space bullae of considerable size are formed.

PATHOLOGICAL HISTOLOGY:- The most noticeable changes in the lung tissue are the increased size of the alveoli, which are greatly distended, and the atrophy, the thinness of the alveolar walls. These in places are hardly more than threads in thickness, and in many places have ruptured. Where this rupture has occurred it will be seen that no haemorrhage has taken place as would be expected, the reason being that as the atrophy of the walls progressed the capillary net-work shared therein and the vessels became impervious to blood before rupture took place. Occasionally however a slight haemorrhage is met with. During the progress of atrophy and dilatation the alveolar epithelium usually undergoes a fatty degeneration and at times small droplets of fat may be seen within these cells.

SECONDARY EFFECTS OF EMPHYSEMA:- Owing to the extensive obliteration of the pulmonary capillaries there is obstruction to the flow of blood through the lungs which in time leads to an hypertrophy and subsequent dilatation of the right ventricle. When the condition is extreme and the cardiac changes not fully compensatory the result is general passive congestion of the abdominal organs.

Emphysema and tuberculosis rarely occur in the same lung, except in the case of localised vicarious emphysema dependent upon the tubercular consolidation.

COLLAPSE OF THE LUNG.

ATELECTASIS.

DEFINITION:- A condition resulting when a part of a lung which has once functioned becomes airless.

ETIOLOGY:- Collapse of the lungs may be met with under a variety of circumstances.

1. In those who before death have been unable to take full inspirations. In these cases the collapse is usually in the lower and posterior portions of the lungs.
2. In weak new-born children. Here the collapse is usually found in patches at the periphery, especially near the root and base of the lung.
3. In any case where pressure is brought to bear upon lung tissue as by aortic aneurism, spinal curvature, contraction of a thickened pleura, or by collections of air or extensive pleuritic effusions in the chest cavity. Under the latter condition the lung becomes compressed against the upper posterior part of the thoracic cavity.
4. In broncho-pneumonia, where there are at times found lobular areas of collapse, probably due to plugs of mucus acting as ball valves at the mouths of some of the smaller

bronchial tubes, which allow the air to pass out of the portion of lung supplied by them but which immediately fall back on inspiration and permit no air to pass into the lung beyond that point. It is also stated that the oxygen of the enclosed air is first absorbed by the blood, then the carbon dioxide and finally the nitrogen, the lung gradually shrinking to its foetal condition. (Lichtheim).

PATHOLOGICAL ANATOMY:- In areas which have become collapsed the tissue is firm, tough and fleshy and of a reddish color; the alveoli are obliterated and their walls are usually congested because the part no longer expands and contracts with each respiration. Small portions of collapsed lung sink readily in water. At first the alveolar walls are simply in contact and should air again enter the tissue they would separate and the alveoli resume their normal shape. After a time however adhesion takes place the tissue being transformed into a compact mass (carnification). It thus loses all resemblance to normal lung, the septa become thickened. Where the alveoli are not entirely obliterated they become filled with exfoliated cells, their epithelial lining being for the most part lost. In other cases there is an extensive formation of fibrous tissue. Where the atelectasis is due to the pressure exerted by an extensive pleuritic effusion the lung frequently becomes bound down by adhesions so that expansion is impossible. In these cases the lung is usually anaemic, and it may be oedematous. In cases of lobular collapse each of the atelectatic lobules appears as a leaden looking patch usually depressed somewhat below the surface of the surrounding lung. (See Broncho-pneumonia). The tissue is congested and there is emphysema of those lobules which are supplied by the other branch of the bronchial tube, one portion of which has become plugged and so lead to the collapse.

PATHOLOGICAL HISTOLOGY:- Under the microscope the chief change to be seen is the absence of alveolar space.

The walls of the air vesicles are everywhere in apposition and in that the capillary vessels are seen to be engorged. In some cases there can be seen an increase in connective tissue in the collapsed areas.

The airless condition of the lungs in still-born children which closely resembles atelectasis, is spoken of as Apnoea-tosis.

PULMONARY OEDEMA.

DEFINITION - A condition of the lungs characterised by the filling of the alveoli, the bronchioles, and at times even the larger bronchi, and the soaking of the interstitial tissues with plasma which has escaped from the capillaries.

ETIOLOGY - Pulmonary Oedema may be due to a variety of causes. (1). It is very frequently associated with the death agony as a result of the gradual failure of the heart, probably in many cases appearing when the out-flow of blood from the pulmonary veins is hindered by some obstruction which the right ventricle has not the power to overcome. (Cohnheim). (Welch). (2). It is most frequently noted in cases of severe congestion as well as in inflammatory conditions of the lungs, pulmonary tumours, haemorrhagic infarcts, etc. (3). At times it is found when all signs of a preexisting engorgement, or of any of the conditions just mentioned are wanting. In these cases the oedema is usually widely distributed and is probably referable to alterations in the capillary vessels due to the disease from which the patient has suffered. In this way is probably to be explained the oedema resulting from the inhalation of irritant gases as well as the typical form of this condition seen in those who have died from anaemia and Bright's disease.

PATHOLOGICAL ANATOMY:- The lungs are heavy; they frequently have a gelatinous appearance, put on pressure and when large quantities of fluid escape which is either clear or if the oedema be dependent upon congestion, bloody. The favorite situation for pulmonary oedema is at the base of the lungs, though as already mentioned it may exist throughout the entire organ.

PATHOLOGICAL HISTOLOGY:- Rarely do we have an opportunity to note the microscopic appearances in oedema because of the readiness with which the fluid escapes from the tissues when cut. If however, we have before cutting the lung, tied off a small portion of the oedematous tissue and caused the serum within the alveoli, bronchioles and interstitial tissue to be coagulated, we will be able to make out easily the great amount of such fluid within the lung, and the extent to which at times the alveoli are distended by it. Within the coagulated serum will be seen a varying number of swollen cells from the epithelial lining of the alveoli and bronchioles, and a small number of leucocytes in some cases may be present.

CHRONIC PASSIVE CONGESTION OF THE LUNGS.

SYNONYMS: Venous congestion, Passive hyperamia, Brown Oedema, Brown induration of the lung. Venous engorgement.

DEFINITION: - A condition of overfulness of the pulmonary capillaries with venous blood due to some hindrance to the outflow of blood from the lung.

ETIOLOGY: - We may recognize two forms of passive congestion of the lung, the one mechanical and the other known as hypostatic. Mechanical obstruction to the outflow of blood from the lungs is most frequently caused by valvular lesions of the left side of the heart with broken compensation. Thus for example, if the mitral valve is incompetent, allowing at each systole a certain amount of blood to regurgitate into the left auricle the result will be that the inflowing blood from the pulmonary veins will find a part of the left auricle already occupied, and in consequence less blood will be able to enter from the lungs, causing a certain amount to remain in the pulmonary veins and ultimately damming back a like amount in the capillary system. The same effect is of course indirectly produced by lesions of the aortic valve. (Explain the production of passive congestion of the lungs by aortic stenosis). New growths or masses of enlarged lymphatic glands pressing upon the pulmonary veins will likewise interfere with the efflux of blood from the lungs and lead to passive congestion.

The causes of hypostatic congestion however are not so simple. This form of passive congestion is dependent upon an interference with one or more of the factors which maintain the circulation against the force of gravity. These factors may be briefly stated to be (1) the propelling power of the heart; (2) the so-called "aspiration of the thorax", the suction action of the chest, by which, at each inspiration the blood in the large venous trunks is as it were drawn into the heart, and (3) the movements of the skeletal muscles (in conjunction with the valves of the veins), their contractions helping to force the blood upward, while the venous valves prevent

the blood is elevated from falling back. If now we have any or all of these factors in the maintenance of the circulation, impaired the tendency will be for the blood to flow less vigorously against the force of gravity, and consequently to stagnate in the most dependent portions of the body. In such conditions as prolonged fevers, or whenever it becomes necessary for a person to occupy, for any length of time, a recumbent position, especially if the vital powers are diminished, we have not only a weakened heart's action, but also shallower respirations and an entire absence of muscular movements, the result being that in such dependent portions of the body as the bases of the lungs, the under portions of the liver, kidneys and spleen, the calves of the legs, the buttox, etc. all become over-filled with the blood, not because of any mechanical obstruction to the outflow of blood from the parts, but because of the weakened force of the circulation. (See Lecture Notes on Passive Hyperaemia).

PATHOLOGICAL ANATOMY: - As a rule the lungs are voluminous and of a deep reddish-brown color cut and torn with difficulty and are heavier and firmer than the normal organs. In some cases the tissue bleeds freely when incised, while in others the organs are remarkably dry. At times there is considerable oedema. The color of the cut section is at first of a dark red, which however soon turns to a much brighter shade owing to the oxidation of the abundant haemoglobin. In advanced cases scattered over the cut surface there are irregular shaped patches of semi-solid lung tissue which have a rusty brown color and are dryer than the surrounding parts. Although as a rule the tissue will float in water, occasionally one of these patches will sink. To this extreme form of passive congestion in which the tissue is almost airless the terms "Hypostatic Pneumonia" and "Splenaization" have been applied.

PATHOLOGICAL HISTOLOGY: - When examined microscopically it is seen that (1) the capillary net work is exten-

60.

fully engorged with blood. One can frequently follow the twisting course of an individual branch for some distance and note that it rises from the alveolar wall in the shape of a loop and projects into the alveolar cavity for some distance. If the specimen has been hardened in formal (see appendix) these capillaries take on a brilliant red color and can be readily made out.

(2) Within the alveolar wall and in the peribronchial and perivascular lymphatics one can see small masses of pigment, at times free in the tissue and again contained within cells.

(3) Within the alveolar space the following structures can be seen. (a) A moderate number of red blood corpuscles some of which are undergoing disintegration. (b) Pigment granules which are derived from the disintegrating red cells. (c) A number of leucocytes and epithelial cells shed from the lining membrane of the alveoli, both of which in many cases contain pigment granules.

(4) Frequently it will be seen that there is an increase in the connective tissue elements in the alveolar walls. Occasionally fibrin, such as is found in the exudate of red hepatization is present in a few alveoli, but this is exceedingly rare. At times also there will be found small hemorrhages filling up a few alveoli.

The bronchial tubes are found to be congested, the mucous membrane having a deep turgid appearance. The epithelial lining is usually wanting and the basement membrane is thickened and oedematous. The capillary vessels are all intensely engorged.

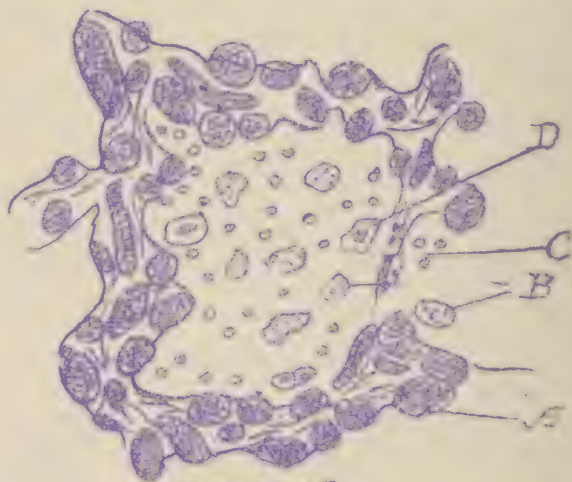


FIGURE 13.

Chronic Passive Congestion.

- A. Engorged Capillaries in alveolar walls.
- B. Pigmentary Cells.
- C. Red Corpuscles.
- D. Exfoliated Epithelial cells

HAEMORRHAGIC INFARCTION OF THE LUNGS

PULMONARY APOPLEXY

DEFINITION: - The term haemorrhagic infarction is applied to an effusion of blood into the pulmonary alveoli and interstitial tissues following embolism of terminal branches of the pulmonary artery. Actual haemorrhage as from rupture of an artery does not take place, but the blood escapes from the vessels by diapedesis. (See Lecture Notes on Thrombosis and Embolism).

PATHOLOGICAL ANATOMY: - Haemorrhagic infarctions are firm red, wedge-shaped masses usually situated just below the pleura with the base toward the surface of the lung. When recent they are bronish red in color and where they reach the surface of the lung the pleura covering them is generally inflamed. Occasionally infarctions occur singly, but more frequently they are multiple and are found scattered over the greater portions of a lobe.

NOTE - In the case from which the present sections were taken there were multiple infarcts in all the lobes of both lungs dependent upon extensive pulmonary embolism.

In size infarcts vary from that of a pigeon's egg to that of an orange, or even much larger, (in the adult). The affected portion of the lung is impervious to air.

PATHOLOGICAL HISTOLOGY - Under the microscope the alveoli are seen to be filled with red blood coagula. Sometimes, though not frequently the alveolar septa are broken here and there. Blood is also seen in the alveolar walls which are compressed and in which fewer nuclei than normal can be made out on account of the coagulation necrosis (See Lecture Notes on Necrosis) which occurs soon after the infarct has been formed. If the infarct be very young no changes will be seen about its borders which are

sharply defined and surrounded by normal lung tissue. If however it has existed for some time the surrounding tissue will be oedematous and congested, or there will be evidence of inflammation or the accumulation of leucocytes which will be seen to form a definite zone about it. (See Lecture Notes on Thrombosis and Embolism). In cases of haemorrhage into the lung tissue from rupture of a small vessel the same changes will be seen.

ETIOLOGY:—Haemorrhagic infarction of the lung is most frequently associated with cardiac disease; it appears most often when the right cavities of the heart have become weakened and dilated, and thrombi have formed in the right auricle and ventricle. It is from these thrombi that emboli are carried away into the branches of the pulmonary artery. Thrombi may themselves also be formed in the pulmonary arteries, and it is possible that occasionally thrombosis of the peripheral veins may lead to embolism of the pulmonary arteries with the resultant infarcts.

65

DUST PIGMENTATION.

In the lungs of all, especially of those who live in cities there is found a certain amount of pigmentation from dust. It is this which gives to the lungs the mottled appearance noted at autopsies and which in some instances gives to the entire organ a dark bluish black appearance. This is a condition falling short of the deep pigmentation caused by the inhalation of coal dust and yet it is of such constant occurrence that it deserves a passing word of description.

The pigment is derived from various sources and is chiefly composed of particles of soot and dust breathed in in the course of years spent in dusty dirty cities. While normally this amounts in years to only enough to cause a very distinct spotted pigmentation, in those who work in coal mines the lungs become after a year or so almost entirely black.

The distribution of the pigment is wide. It is found rarely in spots in the costal pleura, and very commonly in the visceral pleura, the deposit being in the deeper layer while the superficial layer is free. The bronchial glands contain large quantities of the pigment and are sometimes jet black. Along the course of the interlobular septa there is some pigmentation, and in the perivascular and peribronchial lymphatics there is usually a considerable quantity. In those who have worked in coal mines the pigment is even more widely distributed, occurring sparingly in the alveolar walls, in disorganized epithelial cells, and in the lymph-adenoid bodies of the lung.

The inhaled pigment rapidly finds its way into the lymph channels and it is owing to this fact that we find the distribution just described. The particles are taken up, after passing between the cells of the alveolar membrane,

by the plasma spaces in the alveolar walls and ultimately find their way into the lymphatics which lie about the branches of the pulmonary artery and about the bronchi, which soon come to be injected with them. These lymphatic channels freely anastomose with the lymph spaces in the deeper layer of the pleura, which in their turn anastomose very sparingly with those of the superficial layer. This accounts for the fact this layer contains little or no pigment. All the lymph channels sooner or later find their way to the bronchial glands, and there as it were strain out the pigment, so that they soon become densely filled with it, and on section are seen to be black and not infrequently hard cutting with difficulty and with a gritty feel and sound. The ordinary inhalation of dust and the inhalation of large quantities of coal dust does not excite interstitial changes such as are set up by breathing particles of stone or flint.

ACUTE PNEUMONIA.

SYNONYMS:- "Common," "Lobar," "Croupous" or "Fibrinous" Pneumonia, "Pneumonitis," "Lung Fever," and "Pleuro-pneumonia".

Lobar designates the anatomical seat of the disease; croupous or fibrinous indicates the character of the exudate which accompanies the inflammation; (See Lecture Notes on Inflammation) while the prefix "pleuro" in the term pleuro-pneumonia emphasizes the fact that the pleural covering of the inflamed lobe is frequently involved. Lung fever and pleuro-pneumonia are terms now most frequently applied to pneumonia in cattle.

DEFINITION:- Acute pneumonia is an infectious disease characterized by inflammation of the lungs and constitutional disturbances of varying intensity. (Osler).

ETIOLOGY:— The diplococcus pneumoniae, or pneumococcus discovered by Fraenkle, and by him asserted to be the cause of this disease, is found to be associated with every case and is now believed to bear a definite causative relation to it. It undoubtedly is the exciting cause, but it appears that predisposing causes are likewise necessary, as the organism has been found to be present in the mouths of at least 20% of healthy people. Such predisposing causes are most frequently found in exposure to cold, hardship, alcoholism, and not infrequently in traumatism. In addition certain diseases seem to render the system more susceptible to pneumonia. Of these Bright's disease, diabetes, prolonged attacks of fever, chronic nervous diseases and a previous attack are the most important. All of these conditions by lowering the vitality of the individual give to the specific cause of the disease, the pneumococcus, the conditions necessary for its rapid growth and development, with its consequent poisonous effect upon the system, shown most prominently as an inflammation of the lungs.

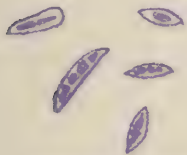


FIGURE 14.

PNEUMOCOCCUS.

Showing Capsule, as seen in the blood mouse inoculated with pneumococcus

development, with its consequent poisonous effect upon the system, shown most prominently as an inflammation of the lungs.

Males are more frequently affected than females, and the disease, which occasionally occurs in epidemic form, is found in all climates from the warmest to the most severe.

MORBID ANATOMY:—The chief stress of the disease falls upon the lungs the changes in which are usually grouped into three stages as follows:—

- I. Stage of engorgement
- II. " " Red Hepitization.
- III. " " Grey Hepitization.

STAGE OF ENGORGMENT.

PATHOLOGICAL ANATOMY:— On opening the chest the vessels of the pleura are seen to be greatly congested and

66

beneath thus lies the deep red color of the lung tissue. To the touch the organ is firmer than normal, though portions cut away will still float in water. On section of a lobe there is an escape of bloody fluid, much of which is the fluid of oedema, the color being more of an arterial than of a venous red. Air still enters the lung and crepitation, though somewhat deadened can still be obtained.

PATHOLOGICAL HISTOLOGY - Under the microscope the chief change noted is a marked engorgement of the capillary vessels which in places can be seen as tortuous red lines running in the alveolar walls and here and there protruding as small loops into the alveolar spaces. Occasionally one of these over-distended vessels ruptures and a small haemorrhage fills a few alveoli. The epithelial cells lining the alveoli are found to be swollen and in places are detached while within the greater number of air spaces lie also a few red and white corpuscles which have escaped from the capillary vessels.

This first stage of engorgement, or active hyperaemia, of the lung is soon succeeded by the second stage, that of

RED HEPITIZATION.

PATHOLOGICAL ANATOMY - Up to this time no inflammatory exudate has been formed but with the beginning of its formation we have the beginning of the stage of red hepitzation. The lobe or lobes which have previously been in a state of engorgement now present certain very characteristic appearances. They are still more voluminous than normal, but do not collapse when the chest cavity is opened have entirely lost the soft feel of normal lung and become as firm and solid as liver tissue. No air now enters the alveoli and there is in consequence no crepitation. The surface of the affected lobe is frequently marked with the imprint of the ribs and the pleura, which was previously congested, is now distinctly inflamed and covered with

thin film of fibrin. The color of the lung is somewhat darker than in the previous stage and a marked change in its physical condition is shown by its greatly increased friability. (it is more easily torn).

The cut section of the lung is dryer than in the previous stage and of a deep reddish-brown color. To the feel and when viewed with the light falling obliquely upon it one can make out a distinct granular condition of the surface. This is due to the protrusion from the cut alveoli of little plugs of fibrinous exudate. The small bronchi are also often found to be plugged with this fibrous material. The lung cuts easily the knife not sinking into the tissue as when normal lung is cut. From the surface a bloody viscous fluid can be scraped, which on examination will be found to contain small granular masses. Portions of the lung tissue in this stage sink readily in water.

PATHOLOGICAL HISTOLOGY :- When studied with the microscope the alveoli are found to be everywhere filled with a fine net-work of fibrin in the meshes of which there are enormous numbers of red corpuscles, a few leucocytes and cells exfoliated from the alveolar membrane. The capillaries have lost the engorged appearance which they presented in the first stage, even appearing to contain less blood than normal. The alveolar walls are infiltrated with leucocytes. The pleura is thickened, the vessels on its deeper layer being engorged while on the surface there is frequently a layer of granular looking fibrin. (See Pleuritis).

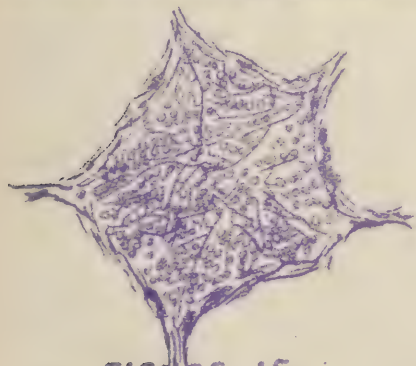


FIGURE 15.

Red Hepitization.

Showing an alveolus filled with red corpuscles entangled in a fine mesh work of fibrin.

When sections are stained by Weigert's fibrin method, (see appendix on methods) the fibrin alone is stained and one gets a clear idea of the extent to which the alveoli are

68

filled with this material. On properly staining for microorganisms (see appendix) the presence of the pneumococcus can be demonstrated in the tissue and in the exudate. Not infrequently other organisms, such as the streptococcus and the staphylococcus can also be found.

This stage

GREY HEPITIZATION.

This stage of red hepitzation passes gradually into the third stage of the disease, that of grey hepitzation. The change does not occur all at once so that upon examining the lung we find that in portions the tissue is in the second stage, in others it is in the third stage while in other parts the transition from red to grey hepitzation is in progress.

PATHOLOGICAL ANATOMY:- On inspection the lung is still found to be larger than normal; it is firm and solid and cuts easily as in the former stage; portions of the tissue sink readily in water and the cut surface has the granular feel and look already referred to. The pleura is coated as in the stage of red hepitzation, with a film of fibrin, and in places the parietal and visceral pleuras may be found to be adherent. The color of the lung tissues has however changed from a dark reddish-brown to a greyish-white and is more moist than before. On scraping the surface with the edge of the knife one removes a creamy, greyish-yellow fluid. The tissue is even more friable than in the stage of red hepitzation.

PATHOLOGICAL PHYSIOLOGY:- Although, when studied with the low power of the microscope, we see that the alveoli are still filled with a net work of fibrin filaments, which on using Weigert's stain are especially well differentiated we find in the meshes of this material not the enormous numbers of red corpuscles as in the former stage, but almost as large a number of leucocytes with a few

exfoliated cells from the alveolar membrane. The red corpuscles have entirely disappeared and the leucocytes have taken their place. In the early part of this stage the exudate completely fills the alveoli as it did in the stage of red hepatization, but as the fibrin grows older it contracts somewhat and being attached to the alveolar wall at one or more points it is drawn away from the other portions leaving a space between it and the wall.

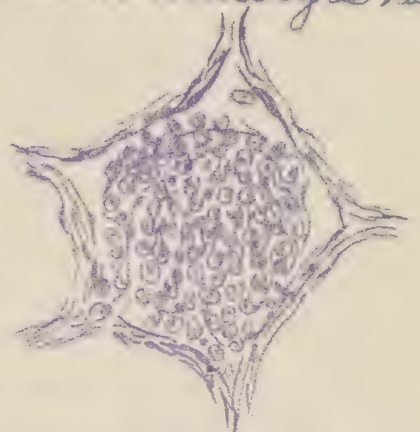


FIGURE 16.

Grey Hepatization

Alveoli partly filled with leucocytes and fibrin. Retracted somewhat from alveolar walls in places.

Grey hepatization may be looked upon as the beginning of resolution and when this proceeds normally the exudate undergoes disintegration and is expectorated in part and in part absorbed so that ultimately the lung is restored to its normal healthy condition. Occasionally however instead of proceeding in this normal manner the organ becomes softer and is extensively bathed with a purulent fluid. This condition is spoken of as purulent infiltration, and when it reaches such an extent that small abscesses are formed resolution rarely, if ever, occurs.

The terminations of pneumonia may be, as already indicated either,

1. Resolution, which is the most common.

2. Purulent infiltration, occurring in about 4% of all cases, or

3. Gangrene, which occurs in about 3% of all cases, and

4. Fibroid induration, chronic interstitial pneumonia, which is the least common, occurring in about 1% of all cases.

(CHANGES IN OTHER ORGANS:-) Although the lungs bear the brunt of the disease and show the most marked changes, other organs also are affected in one way or

another, and the following ^{changes} are most frequently met with.

The spleen is frequently enlarged and softer than normal.

The kidneys in a certain proportion of cases show cloudy swelling (see kidney) and an indefinite granular appearance, especially of the cortical portion.

The heart is usually found to contain firm masses of fat and the right ventricle is frequently very much distended, owing to the impediment that has existed to the flow of blood through the lungs and the consequent extra work which has been thrown on this part of the heart.

Pericarditis and more frequently Endocarditis are found to accompany pneumonia.

BRONCHO-PNEUMONIA.

SYNONYMS: - Catarrhal Pneumonia. Lobular Pneumonia.

The term lobular pneumonia indicates the anatomical distribution of the disease, individual lobules being affected and not a whole lobe as in the acute exudative variety. The term catarrhal is used because of the character of the exudate, which in typical cases contains no fibrin. (See Lecture Notes on Inflammation.) Where the exudate is purely catarrhal in type the term Catarrhal Broncho-pneumonia would be applicable, because we frequently find pneumonias, lobular in distribution, the bronchi having been previously inflamed, but in which the exudate, instead of being catarrhal, contains a greater or less amount of fibrin. In this condition we might with propriety apply the term Exudative Broncho-pneumonia.

71

DEFINITION: - An inflammation involving individual lobules or groups of lobules and the terminal bronchi which supply them.

ETIOLOGY: - The disease although occurring at all ages is most common in the early and advanced years of life. At these extremes also it is most fatal, especially if accompanied by privation or exposure. In children it frequently follows an attack of one of the exanthematous fevers and according to some authorities the deaths from this sequel are more numerous than from the fevers themselves. Inhalation of irritant particles and of irritant gases frequently causes inflammation of the bronchi which rapidly extends to the pulmonary alveoli setting up an extensive broncho-pneumonia. In this way the inhalation of large numbers of tubercle bacilli gives rise to the most severe and fatal form of the disease. (See Tuberculosis). Finally broncho-pneumonia may be caused by foreign matter entering the trachea and ultimately being aspirated back into the smaller bronchi where it excites a most intense inflammation which soon involves the air vessels. This is usually spoken of as "aspiration" or "deglutition" pneumonia and is met with in persons in whom, for any reason, the sensitiveness of the larynx is diminished.

PATHOLOGICAL ANATOMY: - Upon inspection at autopsy, the lungs are usually seen to be somewhat increased in size. Pleurisy, and pleuritic adhesions are rare, though here and there where the surface of the lung shows slightly elevated patches the pleural covering is bluish and tawny in appearance. The organ except in cases of very extensive involvement feels vesicular throughout, generally even more so than normal because of the difficulty with which the air escapes from the tissue. Throughout the substance of the organ firm solid masses can be felt, which represent the patches of broncho-pneumonic consolidation. When one of these patches is at the surface of the organ it is represented by one of the elevated patches above mentioned. These patches

which are more located in the center than about the margins are frequently seen to be surrounded by a zone of emphysematous tissue.

On section the surface is of a dark red color and blood escapes freely. Projecting above the general level of the section there are lighter reddish areas which are the patches of bronchopneumonia. Between these the lung tissue is usually normal or slightly emphysematous, though at times the patches may be so numerous as to occupy the greater portion of an entire lobe. If the knife has cut one of these patches so as to show the bronchus one can make out the following changes.

(1) The bronchiole is somewhat dilated and filled with a mass of exudate which can be squeezed out as a mucopurulent yellowish fluid.

(2) Surrounding this there is an area of greyish-red consolidation which is usually elevated somewhat, as already mentioned. Like the consolidation of acute croupous pneumonia this is sometimes granular to the touch and when looked at with the light striking it obliquely, and for the same reason. (What is the reason?) Frequently however the surface of this consolidation is perfectly smooth. (Why?) If the disease is advanced one may see here and there small white points from which purulent drops escape when the tissue is compressed between the fingers.

(3) Surrounding these areas of consolidation the tissue is darker red in color, smooth, airless and not so prominently elevated. This represents an earlier stage of the disease, and it is probable that the consolidation, or hepatization as it is called is always preceded by this reddened, collapsed condition which is sometimes spoken of as splenization.

The anterior upper borders, and the surface of the lobes are usually emphysematous, while at times one will find small hemorrhages in the pleura and in the lobules adjacent to those which are inflamed.

PATHOLOGICAL HISTOLOGY. - In a cross-section of a small broncho-pneumonic patch we will see the following under the microscope.

(1). About the center of the section passes through it a bronchiole usually dilated and plugged with exudate. Its walls swollen and infiltrated with numerous leucocytes.

(2). In the alveoli surrounding this bronchiole a mass of exudate the character of which is described below, while the alveolar walls present very much the same swollen and infiltrated appearance as does the wall of the bronchi. These signs of inflammation of the ^{walls of the} alveoli and of the bronchial tubes (infiltration with small round cells, and engorgement of the vessels) is a point to which Delafield called attention as marking a distinction between this form of pulmonary inflammation, and acute croupous pneumonia.

CHARACTER OF THE CATARRHAL EXUDATE. - In order to thoroughly understand ~~and~~ the character of the exudate in pure Catarrhal pneumonia one must be familiar with the



FIGURE 17.

Alveolar Cavities - Walls stained with Silver (x450) - (PETER HAMILTON)

- (A) Young granular Epithelial Cells.
(B) Fully developed Squamous Epithelial Cells

normal histology of the lining membrane of the pulmonary alveoli. These spaces are covered by a layer of flat pavement cells which wind around the partitions between the air cells and flatten themselves into all the irregularities of the surface of the alveolar walls. Besides these cells however there are others differing somewhat from them in structure and which are more numerous in the young than in the old. These are irregular in shape, somewhat smaller and have more finely granular protoplasm than the cells just referred to, and are found either singly or in groups. They also

normal histology of the lining membrane of the pulmonary alveoli. These spaces are covered by a layer of flat pavement cells which wind around the partitions between the air cells and flatten themselves into all the irregularities of the surface of the alveolar walls. Besides these cells however there are others differing somewhat from them in structure and which are more numerous in the young than in the old. These are irregular in shape, somewhat smaller and have more finely granular protoplasm than the cells just referred to, and are found either singly or in groups. They also

take up staining reagents more readily and when viewed in profile project somewhat into the alveolar cavity. When large they sometimes show a nucleus, but this is frequently not seen. In all probability these bodies are young, growing epithelial cells, though various theories have been advanced to account for them.

Now when we carefully study the exudate of a pure catarrhal pneumonia with the high power lenses we can make out the following structures which lie in a mucous substance.

(1.) Large cells with finely granular protoplasm in which can be seen one or more nuclei. Sometimes these nuclei show all the evidence of division, and the inequality at times noted in the size of the nuclei within a cell would tend to confirm the opinion that nuclear and cell division was going on.

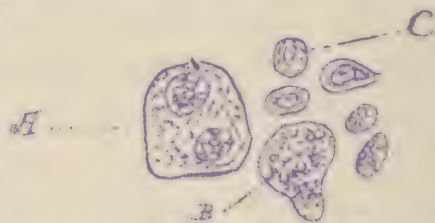


FIGURE 18.

Cells from the exudate of Acute Catarrhal Pneumonia

- A. Large Cell with granular nuclei
B. Cells having become fatty
C. Smaller Cells with single nuclei
Some are fatty.

(2.) Large cells very much like those just mentioned, but instead of showing the signs of active growth showing those of degeneration. These frequently contain fat droplets and in some cases can be seen to be disintegrating. These are probably the same as those first described.

(3.) Much smaller cells, very finely granular, which, like the first frequently show signs of increasing in number.

(4.) The same cell only showing signs of fatty degeneration.

(5.) Finally a certain number of leucocytes are seen, but these are usually fewer in number than the other cells mentioned.

The great mass of cells then are evidently not derived from the blood, but are more epithelial in type. These are undoubtedly derived from these germinal cells above described as occurring singly or in groups, and as smaller and more irregular in shape than the pavement cells which form the

greater mass of living cells. When a catarrhal pneumonia is set up these cells rapidly increase in number and by repeated sub-division give rise, with the cast-off pavement cells and the leucocytes derived from the blood to the great mass of cells which form the pneumonic exudate. Occasionally when a good profile view is obtained of an alveolar wall, these germinating cells can be seen as swollen granular bodies clinging to the alveolar wall, while near them are frequently to be found small clumps of cells evidently derived from them and lying free within the alveolar space. Some alveoli will be found which are entirely lined by these cells and when this is the case the older flat cells have been cast off and are to be found as fatty degenerating bodies in the exudate.

TERMINATIONS: - These may be as follows.

- (1) Resolution which occurs in the greater number of cases.
- (2) Abscess formation which is comparatively rare.
- (3) Gangrene which is also infrequent.
- (4) Interstitial pneumonia, (Chronic) which is the most infrequent of all terminations.

Cavitation does not occur unless the broncho-pneumonia be of tubercular origin, or unless a simple broncho-pneumonia becomes secondarily infected with the tubercle bacilli. (See Tuberculosis).

CHRONIC INTERSTITIAL PNEUMONIA.

SYNONYMS: Emphysema of the lung. When of tubercular origin the term Fibroid Pleuritis is applied to this condition.

DEFINITION: - A morbid condition characterized by a gradual increase in the connective tissue of the lung, leading to induration and a slow obliteration of the pulmonary alveoli.

VARIETIES: - Depending upon various circumstances, there are a number of different forms which fibroid changes may take. For our purpose however it will be enough to recognize two varieties, 1. the local, which involves but a limited portion of the lung, and 2. the general, or diffuse, which involves either an entire lobe, or at times the greater part of the whole organ.

ETIOLOGY: Chronic interstitial pneumonia is very rarely, if ever, a primary, independent, affection. It is dependent upon one or another of the following conditions.

The local variety is always an accompaniment of tuberculosis, and it is also found in connection with such conditions as syphilitic gummata, tumours, abscess cavities, hydatids, old hæmorrhagic infarcts, etc.

The diffuse variety occurs under the following conditions:

1. As a sequence of acute croupous pneumonia. (rare).
2. Dependent upon inflammation of the pleura. This form is usually spoken of as Pleurogenous Interstitial Pneumonia.

The invasion takes place from the pleura, bands of fibrous tissue growing down into the lung from the parietal and spreading out into the pulmonary tissue, frequently following the course of the interlobular septa, obliterating as it grows the alveolar spaces.

3. Following extensive inhalation of irritant dust such as flint dust, the dust from needle sharpening, axe grinding, etc. To this form of the disease the term "Pneumoconiosis"

has been applied. It is essentially a chronic broncho-pneumonia leading to fibroid induration, and is at first practically local, ultimately however involving extensive areas of lung tissue.

The term Chronic Interstitial Pneumonia should be applied only to such cases as are non-tubercular in origin, the term Fibroid Phthisis being reserved for such cases as supervene upon an initial tuberculosis.

PATHOLOGICAL ANATOMY: - Except in cases of pneumoconiosis the disease is usually unilateral, the chest on the affected side being retracted. At autopsy the diseased lung is found to be shrunken and is frequently quite small, while the opposite lobes are large and emphysematous, usually covering a portion of the mediastinum. The heart is drawn outward toward the shrivelled lung. The pleural membranes may be extensively adherent, in which case the interstitial changes are probably of the pleurogenous variety. In other cases there is little or no pleuritic adhesion or thickening. The affected portions of the lung are airless and the lobe is small, firm and not infrequently quite hard. It cuts with difficulty and the cut section has a greyish semi-translucent homogeneous appearance is generally pigmented and shows here and there the cut ends of dilated bronchi. Very rarely small cavities which are not tuberculous in character, may be found. (Charcot Osler.)

PATHOLOGICAL HISTOLOGY: - If the chronic interstitial changes follow an initial acute pneumonia the fibrous tissue is developed "when the cellular infiltration of the parenchyma of the lung is long continued, the circulation at the same time remaining ample for the nutrition of the part." Under these circumstances large fibroblastic cells are first seen in the alveolar walls and in the connective tissue surrounding the bronchi, the blood and lymphatic vessels, and in the interlobular septa. These cells develop into connective tissue in the usual manner. (See Lecture notes on the Development of Connective Tissue) and in this way give rise

to a thickening of the affected parts and to a consequent diminution of the respiratory space. Frequently where the thickening of the alveolar walls is marked it will be seen that the alveoli are lined by short cylindrical, or cuboidal epithelial cells instead of by the flat pavement cells always found in the healthy lung. Where this change is marked the alveoli will strongly resemble the acini of glands. In other portions of the section the alveolar spaces will have been completely obliterated by the new-formed connective tissue. Occasionally fibrous tissue is seen to develop, not only in the walls of the alveoli and in the other localities mentioned, but also in the exudate which still occupies a portion of the air vesicles. Or again one can make out that bud-like processes of connective tissue leave the alveolar walls and make their way into the exudate in various directions, while at the same time there is a formation of new capillaries from those in the alveolar walls, which are to supply the new tissue with nourishment. In this way also the alveolar spaces are obliterated and substituted by connective tissue.

Where the interstitial changes follow pleuritic inflammation definite bands of fibrous tissue will be seen penetrating the pulmonary tissue from the pleura. These correspond to the interlobular septa and form a sort of coarse mesh-work in the interstices of which the lung tissue becomes compressed, sometimes to such an extent that it collapses and remains functionless. The same changes noted above (the substitution of cylindrical, or cuboidal cells for the normal pavement epithelium) can be seen in those alveoli which remain open.

The bronchi as a rule will be seen to be distorted and in some cases dilated on account of the traction exerted by the shrinking connective tissue as it grows older.

PULMONARY TUBERCULOSIS.

SYNONYMS: - Phthisis Pulmonalis. Consumption.

DEFINITION: - An inflammation of the lungs due to a specific micro-organism, the tubercle bacillus, and characterised by the presence of nodules of inflammatory exudate which undergo degeneration into cheesy masses.

ETIOLOGY: - The immediate exciting cause of this disease is the tubercle bacillus, first discovered by Koch in 1882. In order however for the bacillus to exert its characteristic influence the individual must be either predisposed to the disease on account of some hereditary peculiarity in the resisting power of the pulmonary tissue, or must have his normal resistance reduced in some way, exactly how in every case not being clear.

VARIETIES: - Tuberculosis affects the lungs in several quite distinct ways, the difference being due to the channel by which the tubercle bacilli enter the organ and by the amount of resistance offered to its ravages. We can thus recognise the following varieties, the pathology of which we will consider separately. These three are

- I Acute Miliary Tuberculosis
- II Tubercular Pneumonia and Broncho-Pneumonia
- III Fibroid Phthisis.

Before describing the difference between these forms of tuberculosis of the lungs it will be well to understand the histology of a typical tubercle.

PATHOLOGICAL HISTOLOGY: - Mode of formation of a tubercle

The bacilli having once gained access to the pulmonary tissue the following set of changes is set up: -

(1.) The fixed cells of the point, the connective tissue cells, and the endothelial cells of the vessels, begin to proliferate and produce new cells in large numbers. These new cells are round or cuboidal in shape and have each a vesicular nucleus,

that is a nucleus which does not stain solidly as does that of the small mono-nuclear leucocytes, but which has a definitely stained border containing a net work of fine fibers among which can usually be seen one or more nucleoli. These cells are called epithelioid cells because of their resemblance to epithelial cells and not infrequently contain the bacilli.

(2) Owing also to the irritation, the inflammation, set up by the bacilli, there is a migration of leucocytes from the vessels to the area of infection. These cells are called the lymphoid cells.

(3) By the fibrillation of the connective tissue a sort of reticular net work is formed in which these elements lie. This can be seen very distinctly in some cases while in others it is made out with difficulty, or only seen at the margins of the tubercle.

(4) Finally in some tubercles, but not in all, and consequently not an essential part of a tubercle, one sees especially large cells containing many nuclei, either grouped in the center, or arranged about the margins. These are known as the giant cells and are probably produced by the increase in the protoplasm of the cell and the repeated sub-division of its nucleus, without cell division being completed. In many cases these cells contain the tubercle bacilli. It will seem that the more intense the tubercular poison the fewer the number of giant cells formed.

In a typical tubercle then before it has undergone any retrogressive changes we have a nodule composed of epithelioid, lymphoid and sometimes giant cells usually lying in a loose reticulum of fibrous tissue.

When once formed tubercles undergo resolution and necrosis. In the central part of a tubercle, owing to the action of the tubercle bacilli, and to the fact that the tubercle is non-vascular the cells undergo a process of death known as coagulation necrosis (See Lecture Notes). As this advances the cells lose their outline, their nuclei cease to stain and they are finally converted

into a structureless finely granular mass. This process gradually spreads peripherally until the whole tubercle is changed into a yellowish homogeneous cheesy substance. This is spoken of as caseation. After this the tubercle, or the aggregation of cheesy tubercles usually seen, may undergo softening, or may become encapsulated by fibrous tissue or may harden into calcareous masses.

If as sometimes happens, the tubercle does not become caseous there is a great increase in the connective tissue of the part which grows into and through the mass of cells finally converting it into a fibroid nodule. In nearly every case whether the tubercle becomes caseous or fibroid there is a certain amount of connective tissue developed about it. This is especially found in those cases where the inflammation set up is of a minor grade of severity and reactive in nature resulting in the production of cicatricial tissue which tends to restrict the advance of the tuberculous process. In other cases where the inflammation is more severe in character we frequently find in the tissue surrounding the tubercle in a limited area pronounced inflammation, either catarrhal or croupous in character depending upon the severity of the process.

So much then for the general histology of a tubercle. We will now consider the various pathological changes met with in the three varieties of tuberculosis of the lung mentioned above.

ACUTE MILIARY TUBERCULOSIS.

PATHOLOGICAL ANATOMY:- This condition is set up when tubercle bacilli enter the lungs through the circulation and become lodged pretty generally throughout the organ as small embolic masses in the pulmonary capillaries. The organ is usually somewhat more voluminous than normal, is generally congested, is firmer and contains less air than when healthy. The pleura is very frequently seen to be studded with

greyish nodules the size of millet seeds, which if recent are semi-transparent but if old of a distinct yellowish tint.

On section of the lung the surface is usually seen to be of a deep red color and profusely studded with very minute greyish points which stand out somewhat from the surrounding tissue and are each separated from its neighbor by somewhat emphysematous lung tissue. Occasionally these miliary tubercles are so small as to escape notice entirely until the organ is studied under the microscope. In some cases the deposit of tubercles will be very great, while in others it will be scanty. They are uniformly distributed throughout all the lobes and have as nearly as possible the same size everywhere. On closely examining the arrangement of these bodies it will be seen that they most frequently follow the course of the smaller branches of the pulmonary arteries. Less frequently they are aggregated in little clusters, but the individual tubercles do not unite to form larger nodules, as in other forms of the disease, but remain discrete with well defined margins.

PATHOLOGICAL HISTOLOGY:- The structure of these tubercles has already been given. The tissue surrounding them is usually slightly emphysematous as in catarrhal pneumonia. There is also some congestion of the capillaries in the alveolar walls and occasionally there will be a slight grade of inflammation in the alveoli immediately surrounding a tubercle.

TUBERCULAR PNEUMONIA

We may divide this form of pulmonary tuberculosis into three stages as follows.

1. That of acute or sub-acute catarrh.
2. That of caseation.
3. That of ulcerative excavation.

FIRST STAGE, THAT OF ACUTE OR SUB-ACUTE CATARRH:

The first anatomical signs of this form of tuberculosis are practically those of an acute, or sub-acute, catarrhal pneumonia which has already been discussed (See back). The changes are in the great majority of cases first seen at one or the other apex. Whether this early stage of the disease is due to the action of the tubercle bacilli, or whether there is a simple catarrhal pneumonia upon which there is a tuberculous process engrafted has been a matter of dispute. Undoubtedly it is possible for an area of lung tissue suffering from catarrhal pneumonia to become infected with the tubercle bacilli and thereupon to take on the characteristics of a tuberculous process and to ultimately terminate in caseation and ulcerative change, but that all cases of tubercular pneumonia begin in this way is highly improbable as we know that the tubercle bacilli when they find lodgment in healthy lung tissue in some cases, probably due to predisposition, proceed to multiply and set up changes which can not be differentiated from those of ordinary catarrhal pneumonia. It would be best therefore to consider that in some cases there is a primary simple catarrhal, and that in others the process is tuberculous from the first.

After the primary catarrhal changes have lasted for a time other changes set in characteristic of all tuberculous processes, namely, the formation of tubercles and their degeneration and caseation.

STAGE OF CASEATION. - PATHOLOGICAL ANATOMY: - At autopsy one usually finds the lung more or less bound down by adhesions. These are sometimes confined to the apex, but in the majority of cases are quite general. Over the non-adherent parts of the lung there is frequently found a thin film of fibrin. When removed from the body the organ does not collapse as does the normal lung, but resembles in this particular the lung of acute croupous pneumonia; it also resembles this condition in being heavier and firmer than normal. Crepitation can only be obtained here and there while in the

intermediate areas one can feel firm solid masses. Inspection of the surface shows scattered everywhere numerous rounded nodules of hard consistency sharply defined from the surrounding lung tissue.

Upon section the first appearance to attract attention is that of these nodules scattered throughout the lung tissue. If the disease be in a comparative early stage these appear more as patches of a greyish color with indefinite outline, but when advanced they become more definite in appearance and form hard masses with sharply circumscribed borders. In size these vary from that of a pin's head to that of an egg. At times they are found to have coalesced to a greater or less extent so that nearly an entire lobe will have become solidified, producing a condition spoken of as caseous tubercular pneumonia. In other cases the caseous areas will present a lobular arrangement about a bronchus, the condition being one of tubercular broncho-pneumonia. As a rule the nodules are more numerous at the apex of the lobe and in the peripheral portions though in advanced cases they are to be found everywhere. The tissues lying between these masses is usually congested, frequently quite oedematous, and not infrequently the seat of a fibrinous inflammation, appearing pale, though of a different color from the cheesy tuberculous masses. Within some of the caseous areas bronchi can be seen, generally filled with necrotic material.

PATHOLOGICAL HISTOLOGY: - Microscopic examination of a lung in this condition reveals the general appearance of tubercles with which we have become familiar. It will be well however to direct our attention not so much to the caseous areas themselves as to their borders and to the tissues lying between them. In nearly every instance of this disease it will be noticed that about the borders of these masses there is an attempt at the formation of fibrous tissue, which in some instances may have resulted in the production of quite a row of spindle cells lying in a concentric manner about the

tuberculous area. In practically every case this cirrhotic complication is present, though it is in the more chronic cases that it reaches its greatest development. The walls of the bronchi and of the blood vessels can also be seen to be thickened by an increased growth of their connective tissue. Lying somewhat within the zone of fibrous tissue increase there will be found a more or less definite zone of small round cells and still further toward the centre of the tubercular area the cells will be found in a state of degeneration and fragmentation of their nuclei will be readily seen. Within the alveolar wall surrounding these diseased portions of the lung, the capillaries will be seen to be congested. Within some of the alveoli there will also be found a fibrinous exudate.

STAGE OF ULCERATIVE EXCAVATION:- (Chronic Ulcerative Phthisis). Sooner or later all tuberculous processes, except those which are very acute and rapidly terminate in death, proceed to caseation and softening. The great majority of cases thus become chronic in character and are associated with cavity formation and chronic interstitial changes of greater or less extent. Although these cases are primarily of tubercular origin, there is usually a secondary infection, as the disease advances, with the streptococcus, or the staphylococcus, or with both, to which infection many of the symptoms noticed in these cases are due.

When one examines a lung in this stage of the disease all the appearances noted in the stage of caseation are found to be present and to be accentuated. One finds the large areas of caseation, with beginning softening about their centres; the areas of tubercular broncho-pneumonic consolidation and caseation in the same condition; the very large number of smaller tubercles scattered everywhere throughout the lung, a second crop, so to speak, representing a process of extension from the older foci; congestion, oedema, fibrinous exudation into the alveoli surrounding tuberculous areas, and very marked cirrhotic changes everywhere.

The most marked change ^{however}, and the one from which this stage of the disease gets its name, is that of cavity formation produced by the death and absorption of the pulmonary tissue. These cavities usually begin at one or the other apex and by the extension of the necrotic process often increase to such a size that they occupy the most of an entire lobe. These bullous cavities in most cases consist of a series of common or long excavations with ragged walls, (or which there are numerous tubercles in all stages of degeneration, and by whose breaking down the cavity is enlarged) and are filled partly with a muco-purulent material that is sometimes bloody. The process of ulceration usually begins in a bronchus which has become filled with caseous material, and in whose walls there is going on an active tuberculous process. In other cases the excavation begins in the centre of a caseous mass and not in a bronchus. Running across these old cavities one may frequently see bands, the remains of bronchi, or of blood vessels which have not been disorganized. ^{by the necrotic process} It is by rupture of one of these isolated vessels that pulmonary haemorrhage is frequently caused. Going from the smaller ones and from the walls of the cavity makes the contents of these spaces very frequently bloody. Rarely one meets with another variety of cavity which is usually situated at the apex of the lobe and is surrounded by dense connective tissue. The walls of these cavities are smooth. In some instances they communicate directly with bronchi. They are old excavations which have become quiescent though they never heal entirely.

The pleura in nearly all cases of chronic tuberculosis is involved. There may have been only a slight inflammation resulting in the formation of weak thin adhesions, or the process may have been more severe and the resultant adhesions dense and firm so that at times the pleura becomes thickened from a mere delicate membrane to a structure several millimetres thick. This pleuritic inflammation may either be simple in its nature, or tubercular in which latter case there will be

found in the pleura either collections of milky tubercles, or small caseous masses. There may be a pleuritic effusion.

FIBROID PHTHISIS

The changes in fibroid phthisis are so similar to those in chronic interstitial pneumonia that they will not be described separately. Fibroid phthisis is essentially a chronic interstitial pneumonia following upon a primary tuberculous inflammation of the lungs, just as ordinary chronic interstitial pneumonia is frequently the sequel of ordinary acute croupous pneumonia. The term Fibroid phthisis had better be retained to designate the chronic fibroid induration which is of tuberculous origin while the term Chronic Interstitial Pneumonia should be used to designate like changes resulting from all other causes. -
(See Chr. Int. Pneumonia)

ACUTE PLEURITIS.

SYNONYMS: - Pleurisy. Inflammation of the Pleura

DEFINITION: - An acute inflammation of the serous surfaces of the lungs and pleural cavities which may be associated with a fibrinous, sero-fibrinous or purulent exudate.

ETIOLOGY: - The fibrinous variety may be due to exposure to cold, or may be associated with diseases of the lungs such as acute pneumonia, cancer, gangrene or tuberculosis. The sero-fibrinous may possibly be caused by exposure but it is more probable that micro-organisms play an important part in their causation and especially is tuberculosis

an important etiological factor. The furthest variety may follow upon an acute sero-fibrinous pleurisy, it may accompany an attack of one of the specific fevers especially scarlet fever and typhoid fever. It may accompany pneumonia or finally be due to traumatism as by injury to the pleura by a fractured rib.

PATHOLOGICAL ANATOMY: - We may describe this in three stages. In the first stage on inspection the pleura is reddened somewhat, there is distinct engorgement of the vessels some of the larger ones being especially prominent to the naked eye and the normal glistening appearance of the pleura is replaced by a dull semi-opaque appearance and is dryer than normal, and granular. In the second stage these changes are still more marked and there has been a transudation of plasma from the engorged vessel and over the surface of the pleura there has formed a thin layer of fibrin which can be easily scraped off with the finger nail, disclosing a much congested, granular-looking membrane beneath. On section of the pleura in this stage it is seen to be thickened and somewhat oedematous and the lung tissue immediately beneath it is slightly congested and firmer than normal. In the third stage there has been an absorption of the serous exudate and the two pleural surfaces have come together and have become more or less adherent by fine bands of fibrin running from one to the other. Later in this stage however these fibrinous adhesions give place to stronger connective tissue adhesions which have been formed by the organization which has taken place in the plastic lymph which at first held the surfaces in apposition. These adhesions are at times so strong that they firmly bind the lung to the parietal surface and when attempting to remove the organ from the chest cavity it is frequently torn if great care is not taken to break all the adhesions. When a lung in this condition is removed from the body it is seen to be covered by a very much thickened pleura from all parts of

which fibrous bands had away. These were the bands which bound the lung to the parietal pleura. On section the pleura is seen to be very much thickened, and in many places there are distinct bands of connective tissue running from the pleura into the underlying pulmonary tissue, following generally the lines of the interlobular septa and giving rise to that form of interstitial pneumonia called pleurogenous interstitial pneumonia.

PATHOLOGICAL HISTOLOGY: - Beneath the microscope, in the first stage it is seen that there is considerable engorgement of the small vessels of the pleura with red blood corpuscles and at the same time it is noted that there is also a greater number of leucocytes present than in normal blood. Surrounding many of the engorged vessels can be seen accumulations of these leucocytes which have evidently escaped from the vessel. There is also seen to be a rapid proliferation of the connective tissue cells, denoted by the presence of large numbers of small round cells in the tissue which are not leucocytes, and finally the lymph spaces in the pleura seem to be increased in size and to contain more fluid than normal.

In the second stage these same appearances are still visible only more marked, and in addition the pleura is thicker than before, and on its surface there is seen to be a layer of fine fibrin filaments among which lie a greater or less number of leucocytes. Sometimes between this layer of fibrin and the endothelial cells which line the pleura there will be seen to be an accumulation of oblong, or spindle shaped cells, which are cells exfoliated from the endothelial layer just mentioned. In the third stage, that of organization, there is still seen on the surface a layer of fibrin, of greater or less thickness. Below the pleura in the pulmonary tissue there is evidence of congestion. The pleura is seen to be very much thickened and the distinction into two separate layers is less definite than normally, or than

in the earlier stages of the inflammation. The deeper layer of the pleura seems to be poorer, its individual fibers of connective tissue to be increased in size, between which the blood vessels are numerous and engorged. The superficial layer seems to be made up of a more delicate reticular tissue containing large sinuses some of which contain a few red blood corpuscles, and between these there are numerous small loop-like blood vessels shooting up from the vessels beneath. Occasionally one of these will be seen to have ruptured causing a small haemorrhage. Towards the surface the tissue is made up entirely of a granular looking fibrin into which some of the loops seem to be pushing. Between the young vessels that are thus forming there are numerous young connective tissue cells to be seen, some round and small, others more elongated and still others distinctly spindle shaped.

Examine all these changes with the low power of the microscope first and then study them more carefully and in detail with the high power, making drawings of the various shaped cells and of some of the smaller loops of the blood vessels.

Briefly to summarize we may divide pleurisy into the following three stages which have been described.

1. A stage of congestion,
2. A stage of exudation; and
3. A stage of organization.

Pleurisy is an inflammation of a serous membrane and for further details read the section on inflammation of the peritoneum, under inflammation.

&

LABORATORY MANUEL

— of —

Pathological Anatomy.

THIRD PART.

DISEASES OF THE KIDNEY.

CONTENTS:

<u>Chronic Passive Congestion</u>	Page 92
<u>Catarrhal Nephritis</u>	" 95
<u>Chronic Interstitial Nephritis</u>	" 99
<u>Amyloid Disease of the Kidney</u>	" 103
<u>Acute Catarrhal Glomerulo-Nephritis</u>	" 105
<u>" Interstitial " "</u>	" 106
<u>Chronic " "</u>	" 108
<u>Tuberculosis of the Kidney</u>	" 108

THE KIDNEY.

For the normal anatomy and histology of the kidney read works on anatomy and histology.

CHRONIC PASSIVE CONGESTION.

DEFINITION: - A condition of the kidney in which the vessels are overfilled with venous blood, due to some hindrance to the outflow of blood from the organ.

ETIOLOGY - Chiefly chronic valvular lesions of the heart.

PATHOLOGICAL ANATOMY: - The organ is increased somewhat in size and may weigh as much as eight to ten ounces. In consistency it is harder and more elastic than normal. In the majority of cases the capsule is non-adherent, can be easily stripped off and is not thickened. In color the kidney is deep red or even purplish and the stellate veins beneath the capsule can be easily distinguished.

Upon section the medulla and the cortex are both seen to be broader than normal, though the latter is more altered than the former. All the vessels are seen to be very full of blood and blood escapes freely from their cut ends. The malpighian bodies are larger and more prominent than normal.

PATHOLOGICAL HISTOLOGY: - The most prominent and characteristic appearance of the section is the congestion of all the vessels in both the cortex and medulla. These are everywhere greatly distended with blood. In the cortex this is especially noted in the vessels of the glomerular tuft, though in some cases this may, strange to say, be absent. This congestion is also marked in the capillary vessels between the convoluted tubules just around the glomeruli, and beneath the capsule. In the medulla the capillaries lying between the straight tubules appear as rather broad bright red lines. When the congestion is of a severe grade such pressure may

be brought to bear upon the tubules surrounding the engorged capillaries that they become considerably compressed and the epithelial cells which line them, on account of the pressure are injured and in many places become atrophied and disorganized. In the congested tubules of the cortex the epithelial cells are frequently found to be present, but they are rarely shed from the basement membrane. Changes in the tubules and consequent blood casts are of more common occurrence. Blood-pigment such as is found in chronic passive congestion of the liver and lungs is but rarely met with, owing probably to the fact that in the kidney the interstitial blood is very quickly washed away. The albuminuria associated with chronic passive congestion of the kidneys is to be explained by the obstruction which exists to the venous flow and if the cause of the congestion be removed the kidney structure is so little altered that no serious results follow.

Chronic interstitial changes when found in connection with chronic passive congestion are not to be looked upon as the result of the congestion, but as having existed previous to the congestion or as having supervened during its course due to other causes.

NEPHRITIS

DEFINITION - By this term is meant, broadly speaking, any inflammatory condition of the kidney. By many the term is used to cover all the conditions embraced by the term Bright's Disease, while by still others it is employed to indicate other conditions as well. For our purposes we will give it the above definition.

As in the lungs and liver there were found to be various forms of inflammation, that is inflammations affecting the different structures of those organs and running different courses, so in the kidney we find that at one time the interstitial tissue seems to bear the stress of the inflammatory process, while at another it is the parenchyma, the cells of the tubules that are the most severely affected. We thus then recognise a parenchymatous and an interstitial inflammation of the kidney. For the sake of clearness we will consider the inflammatory conditions of the kidney under the following heads, and in the following order:

1. Inflammation affecting the parenchyma of the organ, parenchymatous inflammation. This is usually spoken of as Acute Parenchymatous, or Catarrhal Nephritis.
 2. Chronic inflammation affecting the interstitial tissue and spoken of as Chronic Interstitial Nephritis.
 3. The various forms of waxey infiltrations of the kidney.
 4. Inflammation affecting the various glomerular structures of which we recognise:
 - (a) Acute catarrhal glomerulo-nephritis.
 - (b) Acute interstitial glomerulo-nephritis.
 - (c) Chronic interstitial glomerulo-nephritis.
-

CATARRHAL NEPHRITIS

SYNONYMS - Tubular Nephritis, "Carcinomatous Nephritis", "Disquamative Nephritis". The kidney of Acute Bright's Disease.

DEFINITION - An acute inflammatory process chiefly and primarily of the tubular epithelium.

ETIOLOGY - Exposure to hardships, cold and wet are the most frequent causes of this condition. Alcoholism and the administration of certain poisons also produce it. It is finally a frequent accompaniment of certain general diseases, especially the specific fevers, such as scarlet and typhoid and is sometimes found as a complication of jaundice.

STAGES - For convenience of description this disease is usually divided into three stages as follows -

1. That of acute catarrh,
2. That of fatty degeneration of the tubular epithelium,
- and 3. That of chronic contraction.

FIRST STAGE - THAT OF ACUTE CATARRH.

PATHOLOGICAL ANATOMY - If the body comes to autopsy during this stage of the disease, which is rarely the case, the kidney is found to be increased in size and covered by a thin glistening capsule which is readily stripped off. The color of the organ is usually somewhat paler than normal, though this is not always the case. Upon section the cortex is found to be increased in thickness and to be of a dull greyish color while beneath it the pyramids of the medulla appear in marked contrast because of the congestion of their vessels. Aside from these changes there are no distinctive gross appearances.

PATHOLOGICAL HISTOLOGY - Beneath the microscope one sees that the convoluted tubules of the cortex are more prominent than normal because of the enlargement of their cells. These cells are seen to be much swollen at times.

their increased size completely occluding the lumen of the tube and to be distinctly granular in appearance. This has led to the term of "cloudy swelling" for this condition and under this heading it is sometimes described as a separate condition, from catarrhal nephritis though it is in reality only the very earliest stage of that disease.

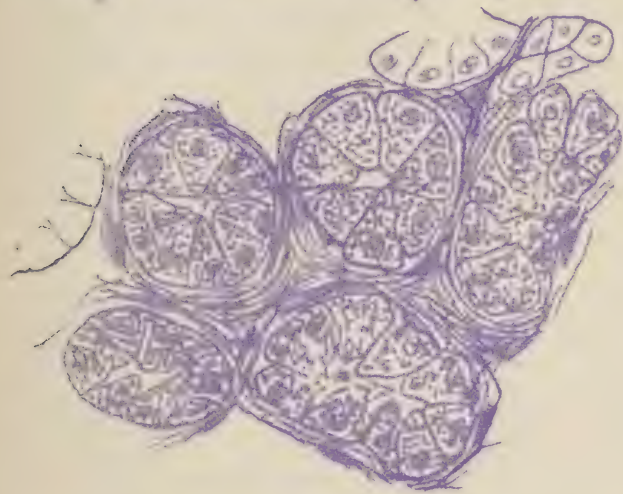


FIGURE 19.

First Stage Catarrhal Nephritis.

Cloudy swelling of Tubercular Epithelium.

completely occlude the same.

The capillary vessels between the tubules and within the glomeruli are usually distended and sometimes ruptured. It is very rarely that one meets with a kidney in just this early stage of inflammation, one usually sees a somewhat later stage when the cells which line the tubules have begun to be shed from their basement membrane and come to lie free in the lumen of the tube in some cases being so numerous as to com-

SECOND STAGE - THAT OF FATTY DEGENERATION OF THE TUBULAR EPITHELIUM.

PATHOLOGICAL ANATOMY:- If the disease is of longer standing, say, from 3-4 weeks duration we will find a somewhat different state of things. The kidney is still enlarged and is heavier than normal. In consistency it is flabby and the capsule as in the former stage comes off readily. The color of the organ is usually brownish or of a mottled yellow and brown appearance. Congestion of the smaller superficial vessels is also marked. When the organ is cut one sees that the increase in

97

the size of the organ as a whole is due chiefly if not entirely to an increase in the thickness of the cortical substance, which is usually from one half to once again as thick as normal and is of a pale brownish yellow color. The medullary portion is little if any thickened and deeply congested.

PATHOLOGICAL HISTOLOGY: - The chief change to be noted when a section is studied under the microscope is the presence of droplets of fat within the cells of the convoluted tubules. This fat is the result of process of fatty degeneration and the cells so affected are seen to stain poorly and in many instances to be broken up into a mass of fatty and granular detritus, which in places entirely blocks the lumen of tubule. Usually the tubules so affected are considerably dilated.

The malpighian bodies are enlarged somewhat chiefly owing to the tufts being swollen from oedema. No fatty changes however are noted in the glomerular epithelium.

In a certain proportion of cases, there is in addition to the tubular changes already mentioned an interstitial complication. Groups of small round cells can be seen chiefly accumulated in wedge shaped masses beneath the capsule, or in some cases scattered diffusely throughout the connective tissue which lies between the tubules. These cells represent a proliferation of the fixed connective tissue cells of the organ, an inflammatory process involving the interstitial tissue as well as the tubular epithelium, a true combination of a interstitial



FIGURE 20

Second Stage Catarrhal Nephritis

Epithelial Cells falling away from basement membrane into lumen of tubules and then breaking up into fatty and granular detritus.

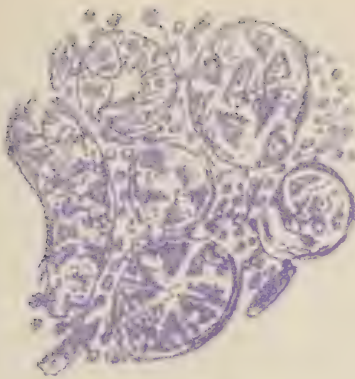


FIGURE 21.

Catarthral Nephritis

Showing degeneration of tubular epithelium, and small cell infiltration of the fibrous tissue between tubules.

Many cases of catarthral nephritis recover before reaching this third and last stage of the disease, but in those cases which linger for some time the changes instead of progressing to resolution become chronic in character, losing the symptoms of catarthral nephritis and taking on the characteristics of a chronic interstitial inflammation. The cases which become chronic are probably those which in the second stage began to show the interstitial complication as just described. In some instances the catarthral changes pass off entirely, or almost entirely and nothing remains but the diffuse increase in connective tissue which by contracting distorts the kidney and reduces its size.

A description of the changes seen in the cirrhotic kidney will be given when we come to study the Small and Granular kidney of primary chronic interstitial nephritis.

THE URINE:- It is scanty in amount and in the earlier stages it frequently contains blood. Albumen is present in large amounts and the specific gravity is high ranging from 1025 to 1035. Fatty, granular, epithelial and blood casts are found in considerable numbers.

DROPSY:- This is a marked feature of the disease and at times is very great. It frequently comes on suddenly and affects the loose tissues under the eyes, the tissues of the genital organs, and the lower extremities. Later in the disease it may become general.

and an interstitial nephritis, which clinically prove to be the most obstinate and incurable cases.

THIRD STAGE— THAT OF CIRRHOTIC CONTRACTION

PULSE AND HEART:- These are not materially affected in the earlier stages. When cirrhotic contraction sets in the pulse tension is increased and there may be slight hypertrophy of the left ventricle.

CHRONIC INTERSTITIAL NEPHRITIS.

SYNONYMS:- "Cirrhotic Kidney" "Gouty Kidney" "Small Red Granular Kidney."

DEFINITION:- A chronic inflammation of the kidney, the focus of which falls upon the interstitial tissue and which is marked by an increase in the same wherever it occurs in the organ.

ETIOLOGY:- Gout is probably the strongest predisposing cause and it is claimed that the uric acid present in the body during this disease is the agent which irritates the connective tissue of the kidney and causes it to increase.

The excessive use of alcohol is instrumental in setting up this disease.

Certain poisons, notably lead, are known to be the direct cause of chronic inflammation of the connective tissue of the kidney.

And finally Syphilis seems also to cause this condition of the kidney in a certain number of cases.

STAGES:- As in the case of catarrhal nephritis we were able for convenience sake to divide the disease into stages, so here also we may recognise an early and an advanced stage of the disease.

PATHOLOGICAL ANATOMY-EARLY STAGE:- In the majority of cases the changes within the organ in this stage are so slight as to cause no gross evidences of the disease. In other cases the slight increase in the connective tissue leads to an enlargement of the kidney which, with the slight adhesions which may exist between the capsule and the organ is

the only points of importance to be noticed at autopsy.

PATHOLOGICAL HISTOLOGY - EARLY STAGE:- The changes to be noted with the microscope in this stage are also very slight. Here and there a few wedge shaped bands of fine fibrous tissue can be seen just beneath the capsule which run for a short distance within the cortex surrounding a few of the convoluted tubules the epithelium of which is generally swollen somewhat and slightly granular. The only other point worthy of note is a slight hypertrophy of the muscular coats of the arterioles.

PATHOLOGICAL ANATOMY - ADVANCED STAGE:- At autopsy the kidneys of advanced chronic interstitial nephritis are as a rule found to be very much diminished in size and to be more or less misshapen, tho' occasionally a case is met with where the kidneys are as large, or even larger than normal and increased in weight. This however is very exceptional. The capsule is found to be thickened and when one attempts to remove it it comes away with difficulty and frequently brings small portions of the kidney substance away with it. Upon removal of the capsule the surface of the organ is seen to be finely granular in appearance, resembling somewhat the surface of the cirrhotic liver, on a much smaller scale. Here and there one usually finds small cysts containing a clear serous like fluid. Some of these are very minute while others are of considerable size and occupy a considerable portion of the thickness of the cortex. Upon section one is immediately struck with the thinness of the cortical substance; it is frequently reduced to less than half of its normal thickness. One may now note the small cysts within the cortex even better than before the kidney was cut. In consistency the organ is tough and inelastic and cuts with difficulty.

PATHOLOGICAL HISTOLOGY - ADVANCED STAGE:- The following minute changes are those most characteristic of this condition.

The capsule seem to be very much thickened and in places to be depressed somewhat. These depressions resemble those seen in the surface of the cirrhotic liver. From the base of these depressions bands of fibrous tissue run into the substance of the organ where they form a more or less complete net work of connective tissue fibers in the midst of which lie the much altered kidney structures, the tubules and glomeruli. Because of the pressure exerted by the contraction of these strands of connective tissue the tubules in many places are mere shrunken remains from the walls of which the epithelial cells, much atrophied and very granular, have separated. Large areas of cortical substance are in this way destroyed. The malpighian bodies likewise suffer from the pressure exerted upon them by the new tissue. The capsule which surrounds them shares in process of connective tissue increase and in many instances can be found to be very much thickened and to have encroached upon the glomerular tuft to such an extent that it is reduced to a fraction of its original size. In some places one can find places where this encroachment of connective tissue of the capsule has been so extreme that no trace of the glomerular tuft remains its place being occupied by a concentric mass of fibrous tissue.

Within the medulla also the increase about the tubules is especially noted and as in the cortex there will be found areas of various sizes in which there is little if any kidney tissue left. Like cirrhotic tissue in other parts we find that it everywhere contains large numbers of small round cells and spindle shaped cells, the small cells being those which have but recently proliferated from the fixed connective tissue cells while the spindle shaped ones are gradually taking upon themselves the characters of the cells from which they are derived.

The formation of cysts in this condition of the kidney is to be explained by the fact that as the bands of connective tissue surround the tubules in certain portions and there partly occlude them by pressure, the portion behind the occlusion which is free becomes filled and dilated with the watery part of the urine which are still excreted and being unable to pass the obstruction distends the tubule until it loses all resemblance to its original condition and becomes converted into a fluid containing sac. As in the early stage of this disease we saw that the muscular coat of the arteries was hypertrophied, so now in this advanced stage this hypertrophy is still more marked.

THE URINE.:- In the early stage of the disease this may be normal in amount, but later it is increased. This increase is probably dependent upon the high arterial pressure which exists during chronic interstitial nephritis. In color the urine is pale and of low ^{specific} gravity (from 1010 to 1015.)

Albumen is usually present in small quantities and may at times be absent. The amount of urea is diminished.

DROPSY.:- If present is slight and may even be absent throughout the entire course of the disease.

THE PULSE AND HEART.:- The pulse is always of high tension, hard and incompressible, and in those of advanced years there is usually a marked degree of arteriosclerosis. Hypertrophy of the muscular coats of the renal vessels, as well as of the arteries generally is present. Hypertrophy of the left ventricle is also present and can usually be easily detected by percussion. These changes together with the passage of an abnormally large amount of urine of low specific gravity, light color, and containing small amounts of albumen are points upon which to base a diagnosis of chronic interstitial nephritis which should be strengthened by the clinical symptoms, age and habits of the patient.

AMYLOID DISEASE OF THE KIDNEY.

DEFINITION:- A condition of the kidney in which the amyloid substance is found deposited in various localities.

ETIOLOGY:- Syphilis, tuberculosis of the lungs or of the bones and wasting diseases generally especially if associated with collections of pus of considerable size are associated with deposits of waxy material in the kidneys as well as in such other organs as the liver and the spleen.

VARIETIES:- We may recognize three; (1) in which the deposit of a waxy material seems to be the only lesion (2) A large waxy kidney, and (3) A small waxy kidney.

SEATS OF THE WAXY DEPOSIT:- The amyloid substance is found to be deposited chiefly within the glomerular tufts in the walls of the vas efferens and of the straight arteries of the medulla and at times in those of the small and middle sized arteries of the intermediate zone. According to some observers the walls of some of the tubules, especially of the larger ones in the medulla sometimes show a deposit of the amyloid material.

I. SIMPLE AMYLOID KIDNEY.

In this condition the kidney seems to be free from all renal disease except the deposit of amyloid material in the localities just mentioned. There are very few gross appearances to mark this condition. The kidney is usually paler than normal and the cortex when treated with a solution of iodine has a speckled appearance, the small spots representing waxy glomeruli.

When examined microscopically after being properly stained small deposits of amyloid are seen in the above mentioned places. The tubules appear to be in a healthy condition and there is no change to be seen in the interstitial tissue.



II. - LARGE AMYLOID KIDNEY.

PATHOLOGICAL ANATOMY: - At autopsy the kidney is found to be considerably enlarged and to be increased in weight. The color the organ is decidedly pale and inconsistent, very elastic. The capsule strips off very readily, leaving a shining, smooth pale surface. Upon section it is seen that the paleness of the kidney is general the medulla being as much affected as the cortex.

PATHOLOGICAL HISTOLOGY: - Upon microscopic examination one finds the amyloid material deposited in the portions of the organ already mentioned as the seats of this disease and in addition it is seen that there are morbid changes in the tubules and interstitial tissue. These in brief consist of a catarrhal inflammation of the tubular epithelium, a catarrhal nephritis, (see Catarrhal Nephritis) and of a diffuse increase in the interstitial tissue. (see the second stage of Catarrhal Nephritis and Chronic Interstitial Nephritis) In these cases we have probably a catarrhal and interstitial ^{nephritis} started up in an organ which was previously affected with amyloid deposits.

III. - SMALL AMYLOID KIDNEY.

The large amyloid kidney is by far the most commonly met with, but we also at times find a small kidney in all respects resembling the small kidney of chronic interstitial nephritis which upon examination we find to be affected with waxy deposits. This form of the disease is in brief only an old cirrhotic kidney within which the amyloid material has been deposited and for this reason it needs no further description. It is probable that if all the cirrhotic kidneys met with were stained for waxy material we would find it present to a greater or less degree in a large proportion of them.

Some observers however look upon this small amyloid kidney as a late stage of the large kidney just described, and from the fact that in that kidney we find the earlier stages of interstitial inflammation it is not unreasonable to suppose that as the new formed tissue contracted the small amyloid kidney was produced. According to this view we would not have a nephrotic kidney in which the amyloid material had been deposited, but a chronic interstitial nephritis supervening in a kidney that was already affected with waxy material.

THE URINE - The quantity is usually large and of low specific gravity. It also contains albumen and casts are rare, when present they are of the hyaline variety.

EDSWY:- In the simple form is slight or absent. In the large amyloid kidney it is at times quite marked.

GLOMERULO-NEPHRITIS

DEFINITION:- Inflammatory conditions affecting the various glomerular structures.

VARIETIES:- We may recognise three chief varieties of inflammatory conditions of the glomerular structures: (1) an acute catarrh of the capsular space. Acute Catarrhal Glomerulo-Nephritis. (2). An acute interstitial inflammation of the glomerulus. Acute Interstitial Glomerulo-Nephritis, and (3) a Chronic Interstitial Glomerulo Nephritis

ACUTE CATARRHAL GLOMERULO-NEPHRITIS

PATHOLOGICAL HISTOLOGY - The chief lesions of this condition is confined to the epithelial cells which line the inner side

of the glomerular capsule. These undergo great proliferation so that in time they come to press upon the glomerular tuft to such an extent that it is seriously injured and its functions consequently greatly impaired. The proliferated cells become flattened out by their mutual pressure so that upon section one at first takes them for fibrous tissue cells, - a closer study of several glomeruli however will show that they are in reality flattened cells derived from the inner lining of the glomerular capsule. In perfectly typical cases of this disease, this is the only lesion of importance, but in most cases there is an accompanying catarrhal inflammation of the tubules. Acute glomerulo nephritis is very frequently associated with scarlet fever.

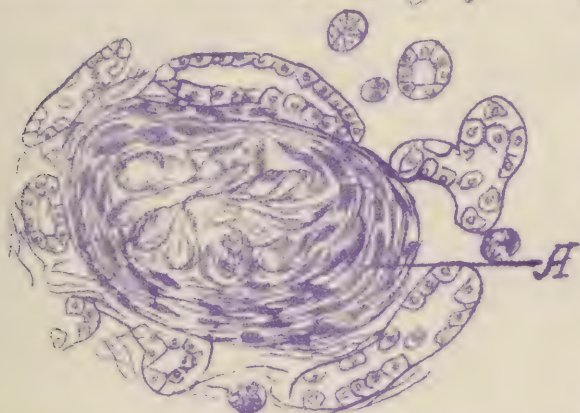


FIGURE 22.

Acute Catarrhal Glomerulo-Nephritis
Showing (A) Proliferation of Cells lining Bowman's Capsule

flammatum of the tubules. Acute glomerulo nephritis is very frequently associated with scarlet fever.

ACUTE INTERSTITIAL GLOMERULO-NEPHRITIS.

DEFINITION:- An acute interstitial inflammation confined to the glomeruli.

PATHOLOGICAL ANATOMY:- The kidney ^{at post} at autopsy to be considerably larger than normal, and to be quite congested. The capsule comes away easily. Upon section the congestion is seen to be most marked in the medullary portions. The cortex is thickened and this thickening accounts for the increase in the size of the organ. In color the cortex is greyish and here and there, when it is examined closely with the naked eye one can see little rounded spots which represent the glomeruli.

127

PATHOLOGICAL HISTOLOGY:—When the glomeruli are

studied with the microscope it is seen that the space which normally exists between the tuft of glomerular vessels and the capsule is entirely obliterated. The whole space within the capsule is diffusely infiltrated with small round cells. These lie not only in the capsular space, but also between the capillaries of the tuft. The general impression given is that the whole glomerulus has been stuffed with small round cells. In the majority of cases the glomerulus alone is the seat of this small celled infiltration, but in a small number of cases a few similar cells may be seen immediately about the glomeruli. Rarely if ever is the general interstitial tissue of the organ affected.

The origin of these small round cells has been variously stated. Some considered that they were derived from the slight tissue that lies between the glomerular capillaries. Others have considered that they were derived from the cells of the capillary vessels themselves while still another view is that they are simply leucocytes which have escaped from the capillary vessels of the glomerulus. It is probable that they are derived from all of these sources and not from any one alone.

The tubular epithelium is usually found to be somewhat swollen and desquamated, and in some instances to be fatty. The changes however are not nearly so marked as in true catarrhal nephritis and are probably the result of the general disturbance in the kidney.

Like the simple variety just described this form of

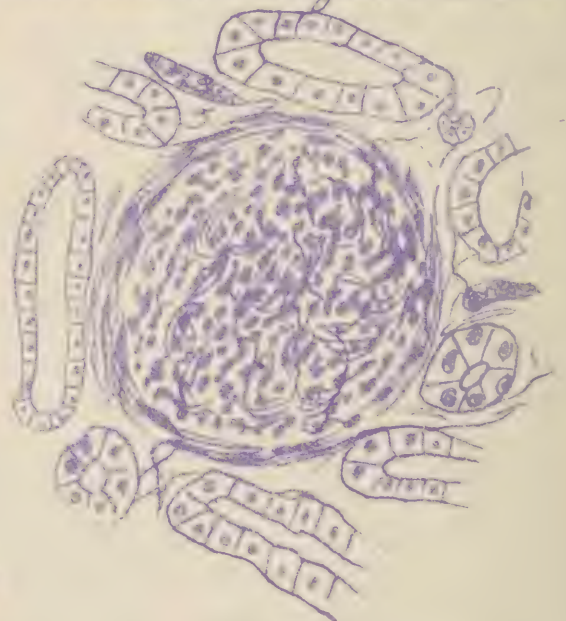


FIGURE 23.

Acute Interstitial Glomerulo-
Nephritis.

Showing infiltration of cells within the
Glomerular Tuft.

108

glomerular inflammation is frequently the sequel of scarlet fever. From the location of the morbid changes it is of necessity a dangerous condition. Both forms just described are more often found in childhood than in middle or advanced life.

THE URINE. - It is usually smaller in amount than normal and is of low specific gravity. It contains much albumen and is frequently bloody.

CHRONIC INTERSTITIAL GLOMERULO-NEPHRITIS.

When death from the acute variety does not result within a short time the disease runs a more chronic course, and the usual changes found in chronic inflammation of fibrous tissue are found to have occurred in the mass of young proliferated cells which we saw in the acute interstitial variety. All the young cells which are at first round, gradually develop into connective tissue fibers, destroying thereby all remnants of the glomerular structure until finally the place of the glomerular tuft is occupied by a mass of connective tissue. In rare cases there seems to be complete recovery from the acute variety.

TUBERCULOSIS OF THE KIDNEY

VARIETIES. - Two are met with, (1) An acute military form, and (2) An extensive caseous variety.

THE ACUTE MILIARY FORM

PATHOLOGICAL ANATOMY. - This form of the disease is always associated with an eruption of miliary tubercles in other organs, it is part of a general miliary tuberculosis, and may be found in some cases of advanced pulmonary tuberculosis, where there are similar lesions in the liver

and spleen, though the kidney seems to be less frequently affected in this way than either of these two organs.

In general the tubercles are found as small white nodules scattered in largest numbers in the cortex and mostly just below the capsule. Frequently when the capsule is removed these are visible to the naked eye as small semi-transparent specks on the surface of the organ. When the tubercles are of any size they can be seen on section as yellowish masses very sharply defined from the surrounding kidney tissue. When found in the medulla they are usually elongated in shape.

PATHOLOGICAL HISTOLOGY:- The histology of tubercle has already been given and as these bodies in the kidney differ in no respect from tubercles in other parts a description of them will not again be given. In some books it is stated that giant cells are comparatively rare in this form of kidney tuberculosis. The author's experience however has been quite the contrary and in specimens given for study it will be found that these cells are decidedly more numerous than in most specimens of tuberculosis from other organs. The tubercles originate within the minute vessels. This is what one would naturally expect, seeing that the tubercle bacilli are brought to the organ by the blood and become lodged in these small blood passages. What may be mentioned as rather distinctive of this form of renal tuberculosis is that these tubercles rarely become sufficiently softened to break down into cavities, except of the very smallest size, this probably due to the fact that the patient dies before time enough for this destructive process to set in has elapsed.



A
LABORATORY MANUAL

— of —

Pathological Anatomy

FOURTH PART.

DISEASES OF THE INTESTINES.

CONTENTS:

<u>Typhoid Intestine</u>	Page 111
<u>Tuberculosis of the Intestine</u>	114
<u>Tropical Dysentery</u>	" 118
<u>Croupous Enteritis</u>	" 120
<u>Tuberculosis of the Peritoneum</u>	121

THE INTESTINES.

For the normal anatomy and histology of the stomach and intestines consult works on anatomy and histology.

TYPHOID LESION OF THE INTESTINE. →

The chief lesion in typhoid fever is found in the intestine. These lesions are located in the ileum; occasionally they will be found in the upper end of the colon about the ileo-caecal valve, but this is rare; still rarer is it to find them in the jejunum and stomach, though cases have been reported in which in these localities there was evidence of the disease.

STRUCTURES AFFECTED: - Scattered throughout the intestine there are numerous collections of adenoid tissue little gland-like bodies which lie in the mucosa and extend somewhat deeply into the sub-mucous coat. Within the ileum these gland-like bodies are particularly numerous and occur in two distinct forms. One of these, the so-called solitary follicles are simple and small collections of lymphoid cells scattered promiscuously throughout the mucous membrane, the other the so-called Peyer's patches are nothing more nor less than accumulations of the solitary follicles, forming masses of adenoid tissue of considerable size; usually oval or oblong in shape with their long axis on the long axis of the intestine. These solitary follicles and Peyer's patches are the seat of the lesions in typhoid fever.

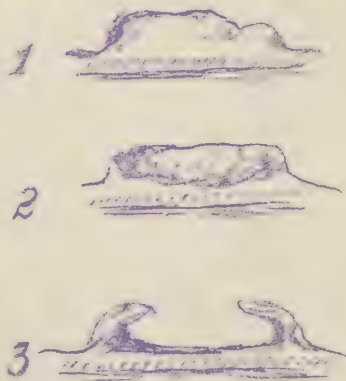


FIGURE 26

Diagram to represent stages of Typhoid lesions in Peyer's patches (Modified after Typhoid fever)

1. Early stage - patch swollen
2. Later. Beginning sloughing
3. Fully formed. Patch with undermined edges

PATHOLOGICAL ANATOMY: - In the earliest stages of the disease the glandular structures above mentioned are simply swollen;

they project visibly above the surrounding surface and are surrounded by a zone of congestions. The swelling is due to the fact that these bodies have become the seat of a small celled infiltration but though they are swollen and prominent they are not hard, but on the contrary quite soft. The cellular infiltration in these cases is probably of an inflammatory nature and is due to the presence of the typhoid bacillus, which even in this early stage of the disease can be demonstrated in the swollen glandular structures. After ten days to two weeks the infiltrated glands begin to slough and leave the ulcers which are characteristic of this disease. This sloughing is due to the fact that the cells which have gathered in such large numbers within the solitary follicles and Peyer's patches become necrotic and broken up into a mass of ill-defined granular material. Their nuclei cease to stain.

THE ULCER:- The ulcer which is produced by the process of necrosis and sloughing has the following characteristics

1. If it be a solitary follicle which has sloughed the ulcer will be more or less round in shape, but if it be a Peyer's patch the ulcer will be oval, with its long axis in the long axis of the intestine.
2. The floor of the ulcer is generally the muscular coat of the intestine and is comparatively smooth, though occasionally there will be a few shreds of the mucosa or sub-mucous coat left clinging to it.
3. The edges of the ulcer are usually unattached, that is the ulcer has undermined the mucous coat, and the edges can be floated up on water.
4. Where the ulcer has not eaten into the muscular coat the serous coat of the intestine will be found to be unaltered, no such thickening being noticed as is seen in cases of tuberculosis of the intestine.

When perforation has taken place it is found that the ulcer has eaten through all the coats of the intestine, the sloughing process not ceasing when the muscular coat

have been reached as is usually the case. In these cases death follows rapidly from peritonitis.

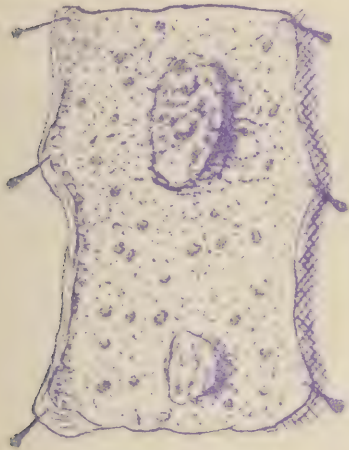


FIGURE 25

Typhoid Fever. Intestine.

Showing infiltration of Peyer's patches and solitary follicles

Where the case of typhoid fever progresses to recovery and the patient dies some time later from some other disease we find upon examining the intestines that there is no evidence whatever of the previous attack of fever. The ulcers therefore heal without the formation of a cicatrix and there is in consequence no con-

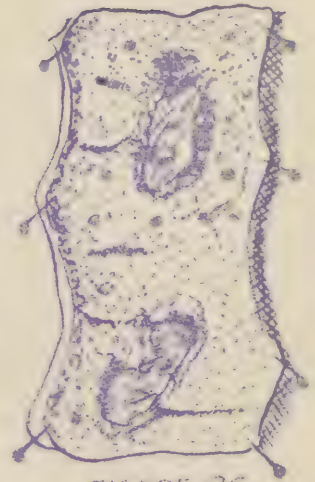


FIGURE 26

Typhoid Fever.

Showing Ulcer and Peyer's patches

striction of the intestine from cicatricial contraction as occurs in tuberculosis.

ETIOLOGY. - The cause of this disease is a micro-organism discovered by Kiebs, Eberth and Koch about the same time (1880-1884). It is a short bacillus which does not form spores and which is actively motile. When caught for within the body it can be found in the intestinal sloughs, and in the intestinal discharges, though in the latter with some difficulty. Within the glandular structures which are infiltrated it can be found in large numbers. It can be found also within the mesenteric glands, in the liver, spleen and kidneys. It is not easily found in the blood.

TUBERCULOSIS OF THE INTESTINE

Tubercular disease of the intestine occurs either as tuberculosis of the mucous membrane, or of the serous coat lining the outside of the gut. The former is almost always the result of advanced tuberculosis of the lungs in the stage of cavity formation, while the latter is a part of a general peritoneal tuberculosis. Very rarely there is seen a primary tubercular infiltration of the mucous membrane. This generally occurs in children and is the result of eating food that is infected with large numbers of tubercle bacilli.

TUBERCULOSIS OF THE MUCOUS MEMBRANE - The chief seat of this form of the disease is the caecum; from this point it diminishes upward and downward, sometimes in severe cases it may be met with as far down as the rectum. Generally the first evidences are met with on the ileo-caecal valve where it takes the form of numerous hard, raised, yellowish projections which are infiltrated lymph follicles. These become caseous at their summit, when ulceration begins the caseous summits soften and small volcano-like pits result.

These may be widely separated, but when they are close together they frequently fuse and form ulcers of considerable size.

THE ULCERS - When we examine these excavations closely we find that they have the following characteristics:

1. Their floor are formed of the sub-mucous coat which is greatly infiltrated with tubercular nodules and is quite rough and necrotic.
2. The edges of the ulcer are not regular as are those of typhoid fever, but are sinuous, infiltrated, and quite hard to the feel. They are not as circular as seen in typhoid or in the typhoid ulcer. The hard edge is caused by

tubercular infiltration, and when we examine it with the microscope we find numerous small tubercles here and there in the border of the ulcer in various stages of degeneration. It is by the breaking down of these tubercles that the ulcer increases in size.



FIGURE 27.

Tubercular Ulcer of intestine

3. As a rule the long axis of the ulcer is transverse to that of the intestine, though the ulcer may be round.
4. The tubercular ulcer rarely perforates.
5. Opposite the base of the ulcer the serous coat will be found to be considerably thickened and infiltrated. To the naked eye this has the appearance of a stellate milky patch. From the centre of this patch one can see tubercles radiating in all directions,

following the course of the lymphatics in the serous coat.

6. Below and about the ulcer there is considerable small round celled infiltration, frequently running through the muscle coats into the serous coat. Here and there both in the submucous and in the muscular coats can be seen small tubercles frequently with giant cells.

This form of the disease then begins in the intestinal lymphoid tissue which absorbs the tubercular poison and within which there are developed small tubercles which following the general rule for tubercles develop to a certain point and then begin to undergo degenerative changes resulting in caseation, softening and the formation of ulcers. These ulcers next

heal, for within their edges there are constantly new tubercles being formed which by breaking down enlarge the ulcer. Here and there at times a partial healing may take place and it is not infrequent for ^{tight} stricture of the bowel to result from such cicatricial contraction



FIGURE 28

Portion of tuberculous ulcer showing infiltration of edge of ulcer, thickening of serous coat below ulcer and tubercle in serous muscular and sub-mucous coats

TUBERCULAR AND TYPHOID ULCERS COMPARED.

TYPHOID ULCER.

1. Edges Undermined. Can be floated off of water; thin, and composed of mucosa and sub-mucosa. Usually red in color
2. Long axis usually in the long axis of the intestine
3. Floor smooth and vascular

TUBERCULAR ULCER.

1. Edges not undermined; thick, nodulated, sloping, Infiltrated with small tubercles. Pale, or red in color.
2. Long axis frequently transverse. Not characteristic.
3. Floor roughened with tubercular nodules. Vascular, with yellowish spots.

4. No thickening of the serous coat

5. Mesentery unaltered. Glands enlarged, soft and pink

6. Perforation, not uncommon, producing peritonitis, Hemorrhage not uncommon.

7. Extension takes place both laterally and in depth

8. Heals by granulation.

9. Does not cause constriction when it heals. Seldom breaks out afresh

10. Microscopically: a specific inflammation of the adenoid tissue; blood vessels distended. Dense masses of small round cells in mucosa and sub-mucosa. Line of demarcation with resulting abscess beginning in the solitary glands and in Peyer's patches.

47 Serous coat over base of ulcer thickened, yellowish, with small tubercles radiating in all directions along lines of the lymphatics

Mesentery thickened at its attachment to bowel. Glands enlarged firm and sometimes caseous

Perforation, peritonitis and hemorrhage all rare.

Extension takes place usually laterally.

Very rarely heals.

Frequently causes constriction of the bowel when it heals. Often breaks out afresh.

Microscopically: a specific inflammation of the adenoid tissue and of the mucous membrane ending in saturation and connective tissue formation. Formation of typical tubercles in the mucosa and submucosa and frequently in the muscular and serous coats. Small round cell infiltration very well marked

TROPICAL DYSENTERY

(AMOEBA COLI DYSENTERY)

DEFINITION. - A form of dysentery found in tropical countries and occasionally in the United States, which is frequently associated with abscesses of the liver.

ETIOLOGY. - An animal parasite, an amoeba, known as the amoeba coli. This organism is found in the coats of the intestine, in the intestinal discharges and in the contents of the liver abscesses.



FIGURE 29

Amoeba Coli from stools of tropical dysentery.
N. Nucleus. V. Vacuole.

GROSS AND MICROSCOPICAL CHANGES.

The disease usually begins and is confined to the large intestine, though according to some observers the ileum is occasionally involved. In the early stages there is much congestion of the vessels of the plexus recti as well as of the mucosa which is frequently of a deep purplish color. Probably the most striking gross appearance is the great thickening of all of the coats of the intestine and, especially of the submucosa which is increased in size not only on account of its oedematous condition, but also by sharply circumscribed nodular accumulations of cells in which there



FIGURE 30.

Amoeba Coli Dysentery Ulcer with both edges much undermined. a. Mucous membrane & Muscularis mucosae. b. Submucosa. c. Muscularis coats. d. Serous coat.

are frequently small cavities filled with a gelatinous looking pus, communicating with the surface of the mucosa by small openings. In some cases these cavities in the mucosa extend up and down as sinuous tracts. By the discharge of their contents these become branched into either small ulcers with undermined edges, or large sinuous ulcers

are frequently small cavities filled with a gelatinous looking pus, communicating with the surface of the mucosa by small openings. In some cases these cavities in the mucosa extend up and down as sinuous tracts. By the discharge of their contents these become branched into either small ulcers with undermined edges, or large sinuous ulcers

frequently running at several points, with extensive sloughs adhering to the sides. A third form of ulcer is sometimes seen which has very slightly undermined edges, representing simply excavations in the thickened submucous tissue. The mucous membrane seems to suffer least, and the lesions in it are chiefly secondary to those in the submucosa. "The process is essentially one of advancing infiltration and softening in the submucous and intermuscular tissue with following necrosis of the overlying tissues." A little distance away from the ulcer there is little or no change in the mucous membrane, and even in cases where it is extensively undermined it may show no changes.

In the bases and about the margins of the ulcers there are large numbers of small round cells, and lying in the tissues beneath the floor of the ulcer one may find in all cases a varying number of the amoeba with which this disease is associated. In addition there will also be seen a number of rather large cells looking very much like the amoeba, though somewhat smaller which are probably detached and enlarged connective tissue cells. The amoeba themselves are large round, or elongated cells, with vesicular nuclei and granular protoplasm which frequently contains one or more vacuoles.

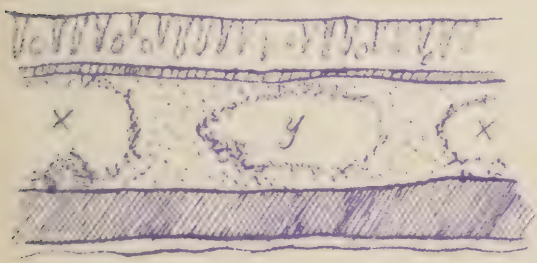


FIGURE 31

Tropical Dysentery. Showing a part of two ulcers (x, x) and an undermining passage in submucosa (y).

In the walls of the ulcers the vessels are very much distended and about these the accumulation of small round cells is very marked. If recovery takes place in these cases the mucous membrane is never restored and years after may be found in a shredded and tattooed condition.

Large abscesses of considerable size are frequently associated with this form of dysentery and it is not an infrequent occurrence for these, when situated in the upper portion of the liver, to break through the diaphragm, and their contents to be evacuated

120

through the lung. In these cases the amoeba coli will be found in the sputum and upon their presence a diagnosis can be made.

CROUPOUS ENTERITIS

SYNONYMS:- English Dysentery. Cholera Nostrans.

DEFINITION:- A croupous inflammation of the mucous membrane of the large intestine.

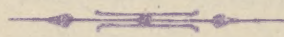
GROSS PATHOLOGY - The mucous membrane of the large intestine is found to be injected and of a dark purplish red color. Here and there can be found a number of small superficial ulcers in the mucosa. Over the surface in many places there is what appears to be a false membrane which is of a dirty gray color and very easily removed by scraping.

MICROSCOPICALLY - When one studies sections of the intestine in this condition one finds that the gray membranous like covering of the intestine, which at first would be taken for a false membrane composed of fibrin, contains very little if any fibrin and is for the most part really a superficial slough of the mucous membrane. In some cases, however though in few, there is a distinct false membrane of fibrin over the surface of the diseased mucosa, but in most cases the necrotic material seen is the remains of the mucous membrane with its contained crypts which has lost its vitality, become fatty and been cast off.

Most of the vessels of the intestine, but not those of the peritoneal covering are engorged with blood, and here and there in the submucosa and between the bundles of fibers in the

muscular coats can be seen extravasations of blood and at other places collections of small round cells.

TERMINATIONS:- Where the disease does not cause death as it does in the majority of cases, there is frequently found a healing of the wounded parts accompanied by extensive cicatricial contraction which may in some cases lead to a great narrowing of the intestinal canal. The scars may be so numerous that but little of the mucous membrane is to be seen.



TUBERCULOSIS OF THE PERITONEUM.

(TUBERCULAR PERITONITIS.)

DEFINITION:- An inflammation of the peritoneum caused by the presence of tubercle bacillus and characterised by a wide spread eruption of milliary tubercles.

ETIOLOGY:- The immediate exciting cause is of course the tubercle bacillus, but how this gains access to the peritoneum is in many cases unknown. In many cases it is supposed to be derived from the intestine.

GROSS PATHOLOGY:- At autopsy the whole peritoneum is found to be injected and in a state of sub-acute inflammation. Scattered over its entire surface there are innumerable small yellowish or translucent nodules varying in size from a pin's head to that of a pea. The larger ones are usually yellowish in color and on section are distinctly caseous. These masses are the tubercles. Great fibrous adhesion of the intestine to adjacent parts and to the parietal peritoneum is usually found and in some cases it is only with difficulty that the intestines can be removed except as one mass. The tubercles are also found scattered

over the capsule of the liver, but are not^{122.} found in its substance. They are also found scattered over the under side of the diaphragm where they have evidently developed within the large lymphatics. Other organs throughout the body may or may not be tubercular.

This disease is entirely different from the tuberculosis of the intestine already described where the mucous and sub-mucous coats are the chief seats of the disease. In these latter cases the peritoneal coat is usually free from tubercles except just over the bases of the ulcers in the mucosa. Likewise in the great majority of cases of primary tuberculosis of the peritoneum there is no tubercular disease of the mucous membrane.

MICROSCOPICALLY:- These tubercles differ in no respect from miliary tubercles in other situations and as their structure has already been given in other places it will not be described here.

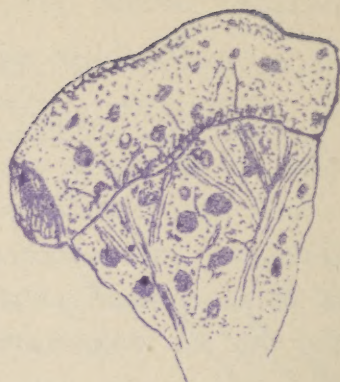


FIGURE 32.

Portion of intestine with Mesentery attached showing tubercular nodules.